Answers

Principles of Mathematics 9 Exercise and Homework Book

Prerequisite Skills

Lowest Common Denominator, page 1

1. a) 12 **b)** 10 **c)** 72
2. a) 30 **b)** 56 **c)** 10
3. a) 15 **b)** 8 **c)** 24
4. a) 9 **b)** 60 **c)** 80
5. a) 6 **b)** 15
6. a) 18 **b)** 60
7. a) $\frac{9}{12}, \frac{10}{12}$ **b)** $\frac{25}{40}, \frac{16}{40}$
8. a) $\frac{8}{24}, \frac{18}{24}, \frac{15}{24}$ **b)** $\frac{12}{24}, \frac{16}{24}, \frac{9}{24}$

Add and Subtract Fractions, page 2

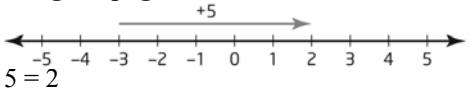
1. a) 1 **b)** $1\frac{1}{2}$ **c)** $\frac{3}{5}$ **d)** $\frac{1}{4}$
2. a) $\frac{7}{8}$ **b)** $1\frac{5}{12}$ **c)** $\frac{11}{14}$
3. a) $1\frac{7}{12}$ **b)** $1\frac{3}{20}$ **c)** $\frac{20}{21}$
4. a) $\frac{1}{6}$ **b)** $\frac{3}{14}$ **c)** $\frac{3}{10}$
5. a) $\frac{13}{30}$ **b)** $\frac{8}{21}$ **c)** $\frac{19}{36}$
6. a) $3\frac{14}{15}$ **b)** $2\frac{1}{12}$ **c)** $\frac{17}{35}$
7. a) $8\frac{7}{12}$ h **b)** $\frac{2}{3}$ h **c)** $\frac{7}{12}$ h

Multiply and Divide Fractions, page 3

1. a) $\frac{6}{35}$ **b)** $\frac{4}{9}$ **c)** $\frac{3}{10}$ **d)** $\frac{7}{15}$
2. a) $1\frac{1}{4}$ **b)** $\frac{13}{30}$ **c)** $11\frac{1}{7}$ **d)** $17\frac{1}{10}$
3. a) $\frac{3}{4}$ **b)** $1\frac{1}{14}$ **c)** $\frac{15}{49}$ **d)** $2\frac{7}{10}$
4. a) $2\frac{2}{9}$ **b)** $\frac{1}{4}$ **c)** $\frac{1}{3}$ **d)** $\frac{69}{91}$
5. $\frac{1}{2}$
6. 4

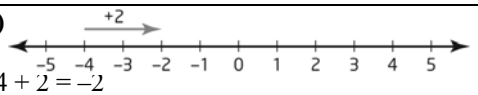
Add Integers, page 4

1. a)



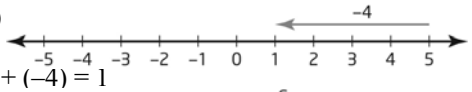
$-3 + 5 = 2$

b)



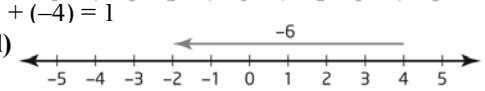
$-4 + 2 = -2$

c)



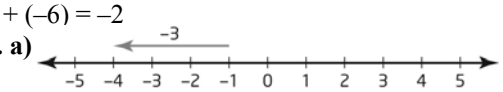
$5 + (-4) = 1$

d)



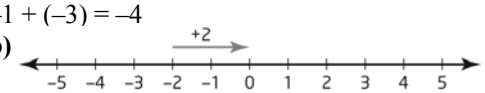
$4 + (-6) = -2$

2. a)



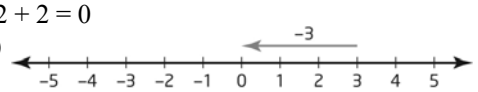
$-1 + (-3) = -4$

b)



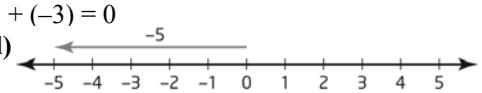
$-2 + 2 = 0$

c)



$3 + (-3) = 0$

d)



$0 + (-5) = -5$

3. a) –2 **b)** 3 **c)** –1 **d)** – 7
4. a) 0 **b)** 0 **c)** –3 **d)** –8
5. a) –10 **b)** 2 **c)** –1 **d)** –2
6. a) –6 **b)** 6 **c)** –3 **d)** –4
7. a) 1 **b)** –12 **c)** 2 **d)** –5
8. a) –4 **b)** 2 **c)** –12 **d)** –8
9. a) 7 **b)** –6 **c)** –1 **d)** –2
10. 5°C
11. $39

Subtract Integers, page 5

1. a) 2 **b)** –2 **c)** 7 **d)** 7
2. a) 0 **b)** 0 **c)** –9 **d)** 6
3. a) –4 **b)** 8 **c)** –10 **d)** –8
4. a) 5 **b)** –2 **c)** 0 **d)** –7
5. a) 3 **b)** 9 **c)** 7
6. a) 2 **b)** –3 **c)** 8
7. a) –3 **b)** –6 **c)** –10 **d)** –3
8. a) –1 **b)** –3 **c)** –10 **d)** –2
9. a) and d) both equal 5; b) and e) both equal –3; c) and f) both equal –5
10. –18°C
11. –7°C

Multiply and Divide Integers, page 6

1. a) 35 **b)** –12 **c)** –18 **d)** 16
2. a) 0 **b)** –28 **c)** –42 **d)** 48
3. a) 3 **b)** –4 **c)** –8 **d)** 3
4. a) 0 **b)** –5 **c)** –4 **d)** 7
5. a) –48 **b)** 0 **c)** 18
6. a) –60 **b)** 48 **c)** 24
7. a) –1, 1, –2, 2, –3, 3, –6, 6, –9, 9, –18, 18

b) –1, 1, –3, 3, –5, 5, –15, 15
8. a) –1, 1, –2, 2, –3, 3, –4, 4, –6, 6, –8, 8, –12, 12, –24, 24
b) –1, 1, –2, 2, –3, 3, –5, 5, –6, 6, –15, 15, –30, 30
9. Answers will vary. For example:
a) $(-4)\times 2$ and $(-16)\div 2$ **b)** $(-5)\times 3$ and $(-30)\div 2$
10. a) $\times 4$; 64, 256 **b)** $\div 2$; –50, –25
c) $\times(-5)$; –500, 2500

Distributive Property, page 7
1. a) 355 **b)** 177 **c)** 92 **d)** 156
2. a) 4.08 **b)** 2.88 **c)** 10.35 **d)** 5.82
3. a) 828 **b)** 645 **c)** 762 **d)** 834
4. a) 21.6 **b)** 6.86 **c)** 26.12 **d)** 39.76
5. a) 205 **b)** 291 **c)** 344 **d)** 774
6. a) 312 **b)** 1212 **c)** 2050 **d)** 3240
7. a) 1386 **b)** 908 **c)** 1542 **d)** 2397
8. a) 9.6 **b)** 39 **c)** 24.6
9. a) 56.63 **b)** 24.12 **c)** 72.32
10. a) 6.34 **b)** 20.96 **c)** 77.67
11. a) 630 **b)** 1160 **c)** 2350
12. a) 18 600 **b)** 21 000 **c)** 26 800

Order of Operations, page 8
1. a) 41 **b)** –4 **c)** 17 **d)** –5
2. a) 29 **b)** 33 **c)** 43 **d)** –12
3. a) 9 **b)** 77 **c)** 20 **d)** 6
4. a) –36 **b)** 2 **c)** 43 **d)** –8
5. a) 1 **b)** 1 **c)** –3 **d)** –36
6. a) 3 **b)** 9.9 **c)** 0.96 **d)** 6.22
7. a) 0.7 **b)** 5.9 **c)** 1.85 **d)** 26.2
8. a) $(16\div 4-5)\times 2^2 = -4$
b) $(16\div 4)-(5\times 2^2) = -16$
c) $16\div(4-5)\times 2^2 = -64$
9. a) $4-2\times 3 = -2$ **b)** $20\div(5-9) = -5$
c) $(10-3)\times(-2) = -14$

Bar Graphs, page 9
1. a) The graph shows that the shopping mall had the fewest number of visitors on Monday and the most visitors on Saturday.
b) The number of visitors increases from Monday to Saturday then drops on Sunday.
2. a) Graphs will vary.
b) Attendance is fairly constant from Monday through Friday, then increases over the weekend.
3. a) The graph shows that the museum had the fewest visitors in January and the most visitors in August.
b) The number of visitors increases from January to August then decreases through December.
4. a) Graphs will vary.
b) Answers will vary. For example: The taxes are lower in the Prairie Provinces.

Measures of Central Tendency, page 10
1. a) mean: 14.8; median: 15; mode: 15
b) mean: 31.6; median: 31; mode: 30
c) mean: 54.4; median: 55; mode: 55
d) mean: 42.8; median: 43; mode: 43
e) mean: 85.6; median: 85; mode: 88
f) mean: 23.4; median: 24; mode: 21
2. a) mean: 33.5; median: 33; mode: 32
b) mean: 54.5; median: 54.5; mode: 54
c) mean: 84; median: 84.5; mode: 85
d) mean: 65; median: 66; mode: 68
e) mean: 45; median: 45.5; mode: 47
f) mean: 93; median: 93.5; mode: 90
3. a) mean: 21.9; median: 23; mode: 23
b) mean: 36.6; median: 36; mode: 34
c) mean: 68.6; median: 66; mode: 64
d) mean: 48.6; median: 48; mode: 48
4. a) mean: 2.16; median: 2.1; mode: 1.9
b) mean: 4.06; median: 4.3; mode: 4.3
c) mean: 6.78; median: 6.45; mode: 6.4
d) mean: 8.77; median: 8.8; mode: 8.8
5. mean: 13.74; median: 13.75; mode: 12.7
6. The mean, since the numbers are centralized.
7. mean: 68.425; median: 68.9; mode: 69.4
8. The median, since there is an outlier.

Scatter Plots, page 11
1.– 4. Graphs will vary.

Linear Relationships, page 12
1. a)

Oranges (kg)	Cost ($)
1	0.75
2	1.50
3	2.25

b) (0, 0) This point shows the cost $0, for 0 kg of oranges.
2. a)

Time (h)	Cost ($)
1	1.50
2	3.00
3	4.50
4	6.00

b) (0,0) This point shows the cost $0, for 0 h of parking.
3. a) Graphs will vary. **b)** week 6
c) (0, 6) This point shows the height of the plant, 6 cm, at week 0.
4. a) Graphs will vary. **b)** 3.5 h **c)** 6 km
d) (0, 0) This point shows the distance, 0 km, for 0 h.

Rational Numbers, page 13
1. a) $\frac{3}{-5}$ **b)** $\frac{-5}{-8}$ **c)** $\frac{-1}{-4}$ **d)** $\frac{-12}{5}$
2. a) 0.8 **b)** –0.7 **c)** –0.375 **d)** 2.75

3. a) $\frac{7}{5}$ **b)** $\frac{9}{10}$ **c)** $-\frac{29}{9}$ **d)** $-\frac{43}{10}$

4. Answers will vary. For example:

a) $\frac{5}{-8}, -\frac{5}{8}, -0.625$ **b)** $\frac{4}{3}, 1\frac{1}{3}, \frac{8}{6}$

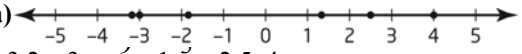
c) $-\frac{3}{4}, \frac{-3}{4}, \frac{3}{-4}$

5. Answers will vary. For example:

a) $\frac{6}{-4}, -\frac{6}{4}, -\frac{3}{2}$ **b)** $\frac{4}{-12}, \frac{-4}{12}, -\frac{1}{3}$

c) $\frac{12}{10}, 1.2, \frac{6}{5}$

6. a)



b) $-3.2, -3, -\frac{2}{5}, 1\frac{5}{10}, 2.5, 4$

7. a) $\frac{2}{-5} < \frac{-3}{8}$ **b)** $\frac{5}{-3} > \frac{-7}{2}$ **c)** $\frac{5}{-4} = \frac{-15}{12}$

Rates, page 14

1. a) 93.75 km/h **b)** 5 km/h **c)** 1.25 m/s
2. a) 2 km/h **b)** 90 km/h **c)** 95 km/h
3. a) \$0.26/lime **b)** \$35.00/pair of jeans
c) \$1.25/cornmeal muffin
4. a) \$1.20/bottle of water **b)** \$0.60/apple
c) \$4.50/mug
5. a) \$0.004/g **b)** \$0.003/g **c)** \$0.0045/g
6. a) 5 mL/cookie **b)** 200 pages/min
c) 30 rotations/min
7. Brand A
8. Brand B
9. Brand A
10. Brand B
11. a) Terri **b)** \$0.50/hour
12. a) Colette **b)** \$0.25/hour

Ratio and Proportion, page 15

1. a) 2:7 **b)** 1:3 **c)** 5:8 **d)** 5:2
2. a) 2:3 **b)** 20:7 **c)** 4:11 **d)** 10:9
3. a) 7:20 **b)** 13:20 **c)** 7:13
4. 525 mL frozen concentrate, 975 mL water
5. a) 3:10 **b)** 9:5 **c)** 6:1
6. a) 9:44 **b)** 15:22 **c)** 5:44
7. a) 300 mL **b)** 1200 mL
8. 120 people
9. 250 people
10. 140 dogs

Percents, page 16

1. a) 5% **b)** 12.5% **c)** 60% **d)** 35% **e)** 124%
2. a) 75% **b)** 62.5% **c)** 60% **d)** 160%
3. a) 45.5% **b)** 33.3% **c)** 44.4% **d)** 28.6%
e) 166.7%
4. a) 0.29 **b)** 0.385 **c)** 0.08 **d)** 1.15
5. a) 5.7% **b)** 146 cm
6. a) 30% **b)** \$112.49
7. a) oxygen 6 kg, carbon 1.2 kg, hydrogen 0.64 kg, nitrogen 0.16 kg
b) oxygen 15 kg, carbon 3 kg, hydrogen 1.6 kg, nitrogen 0.4 kg
8. a) 140% **b)** \$44.00

Powers, page 17

1. a) 4^6 **b)** 7^8 **c)** 3^4 **d)** 11^3
2. a) 2.8^5 **b)** 6.1^3 **c)** 3.4^5 **d)** 1.7^6
3. a) $(-1)^3$ **b)** $(-6)^5$ **c)** $(-3)^4$ **d)** $(-7)^6$
4. a) x^4 **b)** y^2 **c)** m^3 **d)** d^5
5. a) 49 b) 1024 **c)** 10 000 **d)** 1 **e)** 125 **f)** 256
6. a) 27.9841 **b)** 5.37824 **c)** 0.027 **d)** 0.0625
7. a) 146.41 **b)** 1157.625 **c)** 3652.264 **d)** 428.49
8. a) 4^2 **b)** 2^4
9. a) 27^2 **b)** 9^3 **c)** 3^6
10. a) 8^3 **b)** 7^4 **c)** 10^9
11. a) 243 **b)** 8 **c)** 9

Classify Triangles, page 18

1. a) equilateral **b)** scalene **c)** isosceles
2. a) obtuse **b)** right **c)** acute
3. a) right, isosceles **b)** scalene, acute
c) scalene, obtuse **d)** equilateral, acute
4. a) ΔABC, ΔACD, ΔBCD
b) ΔABC is obtuse, ΔACD is obtuse, ΔBCD is obtuse
5. a) ΔMNO, ΔMNP, ΔNOP
b) ΔMNO is right and isosceles, ΔMNP is obtuse and scalene, ΔNOP is acute and scalene

Classify Polygons, page 19

1. a) pentagon, irregular **b)** pentagon, regular
c) triangle, irregular **d)** octagon, regular
e) quadrilateral, irregular **f)** triangle, irregular
g) pentagon, irregular
2. a) rectangle; Two pairs of opposite sides have equal lengths, and all four angles are 90°.
b) square; It has four equal sides and all four angles are 90°.
c) parallelogram; Two pairs of opposite sides have equal lengths and are parallel. The quadrilateral contains no right angles.
d) rhombus; All sides are marked as equal. The quadrilateral has no right angles.
e) trapezoid; No sides are marked as equal.
One pair of opposite sides is parallel.
3. a) ABCF is a rectangle. CDEF is a trapezoid.
b) MNOR is a square. OPQR is a parallelogram.

Angle Properties, page 20

1. 78°
2. 39°
3. 58°
4. a) $x = 110°, y = 70°$ **b)** $d = 25°$ **c)** $m = 32°$

5. a) $a = 97°$, $b = 83°$, $c = 97°$
b) $x = 48°$, $y = 132°$, $z = 48°$
6. a) $x = 62°$ **b)** $y = 78°$ **c)** $z = 78°$
7. a) $x = 82°$, opposite angles; $y = 98°$, co-interior angles; $z = 98°$, opposite angles
b) $x = 117°$, supplementary angles; $y = 63°$, opposite angles; $z = 63°$, corresponding angles

Calculate Perimeter and Circumference, page 21
1. a) 18.8 cm **b)** 19.4 cm **c)** 20 m **d)** 88 mm
e) 21 m **f)** 16 cm
2. a) 15.1 m **b)** 57.2 mm **c)** 21.4 cm **d)** 38.6 m
3. 13.2 m
4. 14.4 m

Apply Area Formulas, page 22
1. a) 53.29 cm^2 **b)** 26.52 m^2 **c)** 11 m^2 **d)** 56.8 cm^2
e) 9.2 m^2
2. a) 15.1 cm^2 **b)** 24.6 m^2
3. a) 58.1 cm^2 **b)** 9.8 cm^2
4. a) 13.6 m^2 **b)** 86 m^2 **c)** 5529 mm^2 **d)** 92 cm^2

Calculate Surface Area and Volume, page 23
1. a) 150 cm^2 **b)** 122 m^2 **c)** 478 cm^2 **d)** 283 m^2
2. a) 125 cm^3 **b)** 84 m^3 **c)** 754 cm^3 **d)** 1257 m^3
3. a) surface area: 294 m^2; volume: 343 m^3
b) surface area: 215.9 m^2; volume: 207.2 m^3
c) surface area: 837.5 cm^2; volume: 1847.7 cm^3
d) surface area: 1759.3 m^2; volume: 3694.5 m^3
4. surface area: 368.9 m^2; volume 374.4 m^3

Use *The Geometer's Sketchpad*®, page 24
1.–5. Answers will vary.

Compare Figures, page 25
1. a) Container A: surface area 1020 cm^2, volume 2700 cm^3; Container B: surface area 2100 cm^2; volume 5000 cm^3
b) Container B **c)** Container B
2. a) Container A: surface area 228 cm^2, volume 288 cm^3; Container B: surface area 264 cm^2; volume 216 cm^3
b) Container B **c)** Container A
3. a) Container A: surface area 1825 cm^2, volume 5850 cm^3; Container B: surface area 2513 cm^2; volume 12 566 cm^3
b) Container B had the greater surface area and volume.
4. a) Container A: surface area 224.7 cm^2, volume 243 cm^3; Container B: surface area 157.5 cm^2; volume 67.5 cm^3
b) Container A **c)** Container A
5. a) Container A: surface area 84 cm^2, volume 24 cm^3; Container B: surface area 217 cm^2; volume 283 cm^3
b) Container B **c)** Container B
6. a) Container A: volume 339 cm^3; Container B: volume 240 cm^3; Container A has the largest capacity.
b) Container A: surface area 254 ^{2}; Container B: surface area 256 cm^2; Container A requires the least amount of material to construct it.

Chapter 1

1.1 Focus on Problem Solving, page 27
1. a) 18, 23, 28; add 5 to the previous term
b) 54, 162, 486; multiply the previous term by 3
c) 32, 256, 8192; multiply the two previous terms
d) 13, 17, 19; the terms are the prime numbers in order
2. 15
3. a) $0.\overline{027}$, $0.\overline{054}$, $0.\overline{081}$, …
b) If the numerator is less than 37, then a group of three digits repeats that is the product of the numerator and 27.
c) $0.\overline{675}$ $(675 = 25 \times 27)$
4. a) $0.\overline{09}$, $0.\overline{18}$, $0.\overline{27}$, …; If the numerator is less than 11, then a group of two digits repeats that is the product of the numerator and 9.
b) If the number is less than 111, then a group of three digits repeats that is the product of the numerator and 9.
c) If the number is less than 11 111, then a group of five digits repeats that is the product of the numerator and 9.
5. 7
6. a) 2 **b)** 5 **c)** 9 **d)** 54 **e)** $\frac{n^2 - 3n}{2}$
7. a) Answers will vary.
b) Answers will vary. For example, ask my parents, use the Internet to find perpetual calendars, count back.
8. 300
9. T = 6, H = 9, A = 2, W = 3, S = 5, E = 7, Y = 1
10.

5	3	2	1	6	8	4	7	9
7	1	8	4	5	9	3	6	2
6	4	9	3	7	2	1	5	8
9	5	4	7	8	3	2	1	6
2	7	3	5	1	6	8	9	4
8	6	1	2	9	4	5	3	7
3	9	6	8	4	5	7	2	1
4	2	7	6	3	1	9	8	5
1	8	5	9	2	7	6	4	3

1.2 Focus on Communicating, page 28

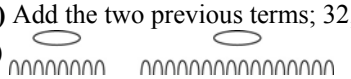
1. a) Subtract 3 from the previous term; 9, 6.

b) Subtract 2 from the previous term; −14, −16.

c) Add $\frac{1}{6}$ to the previous term; $\frac{2}{3}$, $\frac{5}{6}$.

d) Multiply the previous term by −3; 324, −972.

e) Add the two previous terms; 32, 52.

f) 

2. Yes; the area of the triangle on the hypotenuse equals the sum of the areas of the triangles on the other two sides.

3. a) The rectangle is divided into thirds horizontally and three of these rows are shaded to show $\frac{2}{3}$. Then, the rectangle is divided into fifths vertically and three of these columns are shaded to show $\frac{3}{5}$. The overlap of the shading shows the product. Since six parts are double shaded, $\frac{2}{3} \times \frac{3}{5} = \frac{6}{15}$, or $\frac{2}{5}$.

b) $5 \times \frac{1}{2} = 2\frac{1}{2}$

4. Anna: tennis; Bryce: baseball; Coral: hockey; Deepak: swimming

5. The best location would be 3.5 m from the end of the recycling line and a perpendicular distance of 4 m from the line.

1.3 Focus on Connecting, page 29

1.

50¢	2¢	1¢	Values ($)
5	0	0	2.50
4	1	0	2.02
4	0	1	2.01
3	2	0	1.54
3	1	1	1.53
3	0	2	1.52
2	3	0	1.06
2	2	1	1.05
2	1	2	1.04
2	0	3	1.03
1	4	0	0.58
1	3	1	0.57
1	2	2	0.56
1	1	3	0.55
1	0	4	0.54
0	5	0	0.10
0	4	1	0.09
0	3	2	0.08
0	2	3	0.07
0	1	4	0.06
0	0	5	0.05

2. Answers will vary depending on the dimensions of the classroom. A possible estimate can be made using the formula Number of CD players = Volume of classroom ÷ Volume of one CD player (332 cm^3).

3. Add the number of parallelograms with different numbers of triangles: 166.

4. Guess and Test. Start by guessing that Rae ate one piece, then Kees ate four pieces and Jason ate three pieces, then Ming ate three pieces, then Anil ate two pieces and Edgar ate two pieces. This works since 1 + 4 + 3 + 3 + 3 + 2 + 2 = 15. Then, rewrite each person's share as a fraction of the birthday cake.

Rae = $\frac{1}{15}$, Kees = $\frac{4}{15}$, Jason = $\frac{3}{15}$ or $\frac{1}{5}$,

Ming = $\frac{3}{15}$ or $\frac{1}{5}$, Anil = $\frac{2}{15}$, Edgar = $\frac{2}{15}$. This can also be solved algebraically by expressing all amounts in terms of Jason, summing to 15, and solving the resulting equation.

5. Answers will vary.

6. 14

7. Answers will vary.

8.

7	9	3	6	8	5	2	1	4
1	2	5	3	7	4	6	8	9
6	4	8	1	2	9	5	7	3
9	7	4	2	6	1	3	5	8
8	5	1	7	9	3	4	6	2
3	6	2	5	4	8	7	9	1
4	1	7	8	5	2	9	3	6
5	8	9	4	3	6	1	2	7
2	3	6	9	1	7	8	4	5

1.4 Focus on Representing, page 30

1. 2 km west of the starting point

2. Three floors with 12, 6, and 3 offices on the floors. The minimum is three offices because the next highest floor would have 1.5 offices, which is not possible.

3. 435

4. a) 5 **b)** $2\frac{2}{5}$

5. a) Add 2 to the *x*-coordinate and subtract 1 from the *y*-coordinate. D(6, –3), E(8, –4), F(10, –6)

b) Multiply the coordinates by –1. S(–1, –2), T(1, 2), U(–1, –2)

c) Add 1 to the *x*-coordinate and 2 to the *y*-coordinate. G(4, 8), H(5, 10), I(6, 12)

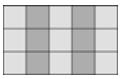
6. (−1, 7), (−1, −3)

7. If AB is not one of the equal sides, then vertex C can lie anywhere on the perpendicular bisector of AB except the point on AB. If AB is one of the equal sides, then the only possibilities for C are (5, –2), (–3, 6), (–7, 2), and (1, –6).

1.5 Focus on Selecting Tools and Computational Strategies, page 31

1. a) 8 squares divided into 2 columns gives 4 squares in each column. 

b) 15 squares divided into 5 columns gives 3 squares in each column.



2. a) 35, 38 **b)** 3072, 12 288
c) −8, −10 **d)** 324, –2916
3. a) $-\frac{4}{5}$ **b)** $\frac{7}{20}$ **c)** $-\frac{4}{9}$ **d)** $\frac{5}{21}$
4. a) $\frac{1}{2}$ **b)** $-\frac{3}{20}$ **c)** $\frac{3}{16}$ **d)** $\frac{1}{10}$
5. a) $-\frac{3}{20}$ **b)** $-\frac{9}{10}$ **c)** $-\frac{1}{20}$ **d)** –2
6. 3971
7. about 111.6 cm
8. $2^{n-1} + 1$

1.6 Focus on Reasoning and Proving, page 32
1. Let the consecutive numbers be $n - 2$, $n - 1$, n, $n + 1$, $n + 2$. Then, the sum is $n - 2 + n - 1 + n + n + 1 + n + 2 = 5n$, which is divisible by 5.
2. Answers may vary. Since a textbook is made by folding sheets of paper in half, there will always be an even number of pages because the number of pages equals two times the number of sheets.
3. a) 6 is an even number not divisible by 4. $\frac{6}{4} = 1.5$
b) 3 and 5 are odd numbers. 3 + 5 = 8, which is an even number.
c) $\frac{1}{2} \times \left(-\frac{3}{4}\right) = -\frac{3}{8}$ is a negative product, not positive.
4. 9 (7, 19, 26, 37, 56, 61, 63, 91, 98)
5. a) 1, 4, 9, 16
b) The sums are consecutive perfect squares.
c) n^2
6. Answers will vary.
7. a) 2 **b)** 2 **c)** 6 **d)** 6 **e)** 14 **f)** 14
g) The sum of consecutive powers of two is two less than the next power of two.
h) $2^1 + 2^2 + 2^3 + 2^4 = 30$; $2^5 - 2 = 30$
$2^1 + 2^2 + 2^3 + 2^4 + 2^5 = 62$; $2^6 - 2 = 62$
i) Answers may vary.
8. a) 9 **b)** 14 **c)** 13 **d)** 46

1.7 Focus on Reflecting, page 33
1. 4
2. $3\frac{1}{4}$
3. a) 33 **b)** 25 **c)** 8 **d)** 50
e) 33 numbers are divisible by 3, and 25 numbers are divisible by 4. However, 8 of these numbers are divisible by both 3 and 4. Subtract 8 from 33 + 25 to get 50. You could check by using a hundred chart and circling numbers that are divisible by 3 or 4.
4. a) 271 **b)** 181 **c)** 35 **d)** 417
e) 271 numbers contain the digit 5, and 181 numbers contain the digit 0. But 35 numbers contain both 5 and 0, so subtract 35 from 271 + 181 to get 417.
5. a) 5 moves
b) −40 + 70 = 30; 30 + (−55) = −25; −25 + 40 = 15; 15 + (−25) = −10; −10 + 10 = 0. Also, you could use a number line.
6. 6
7. Answers will very. Consider how many people are in Ontario and how many people drink bottled water.
8.

2	3	1	8	7	6	4	9	5
8	7	9	4	2	5	1	6	3
5	6	4	1	3	9	2	7	8
4	9	2	6	5	8	3	1	7
7	1	5	3	4	2	9	8	6
6	8	3	9	1	7	5	2	4
9	2	6	5	8	3	7	4	1
1	5	7	2	6	4	8	3	9
3	4	8	7	9	1	6	5	2

Chapter 1 Review, page 34
1. a) 15, 18, 21; add 3 to the previous term
b) 64, 128, 256; multiply the previous term by 2
c) 25, 34, 45; add consecutive odd integers to the previous term
d) −7, −17, −29; subtract consecutive even integers from the previous term
2. a) The x-coordinate increases by 3 and the y-coordinate increases by 2. D(10, 8), E(13, 10), F(16, 12)
b) The x-coordinate decreases by 4 and the y-coordinate decreases by 2. J(−8, −1), K(−12, −3), L(−16, −5)
c) The x-coordinate decreases by 3 and the y-coordinate decreases by 2. S(–15, –7), T(–18, –9), U(–21, –11)
3. a) $\frac{3}{4}, \frac{7}{8}, 1$ **b)** $-\frac{3}{4}, -1, -1\frac{1}{4}$
4. Answers will vary. Consider the dimensions of the milk jug to find the volume. Then, consider the dimensions of and volume of a quarter. The number of quarters will be the quotient of the two volumes.
5. 204; solve a simpler problem, make a diagram
6. a) The new volume is eight times the old volume.
b) The same is true for any cube.
7. a) $(12 + 3) \div 5 - 2 = 1$
b) $\left(\frac{1}{3} - \frac{1}{4}\right) + \frac{5}{6} \times \frac{1}{2} - \frac{5}{12} = \frac{1}{12}$
8. a) $\frac{7}{20}$ **b)** $1\frac{4}{15}$ **c)** $\frac{8}{21}$ **d)** $\frac{22}{35}$
9. a) 302 **b)** 113th term
10. 28; Answers will vary. Use a calculator.

Chapter 2

2.1 Hypotheses and Sources of Data, pages 35–36

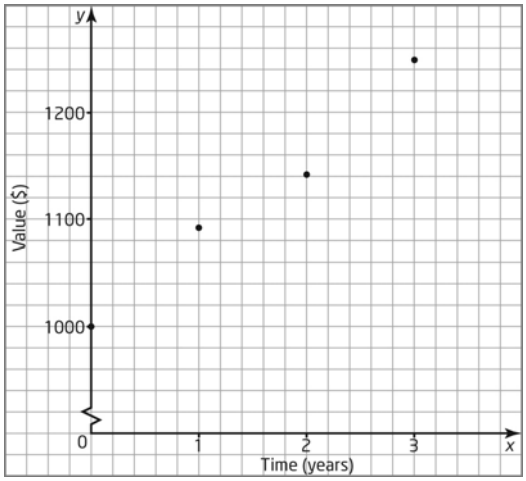
1. a) Most people's favourite colour is not blue.
b) Teenagers do not spend more time listening to rock music than to classical music.
c) Bob's favourite type of ice cream is not chocolate.
d) Most students do not study mathematics.
2. Answers will vary. Examples:
a) Hypothesis: Children tend to grow to have the same shoe size as their fathers. Opposite: Children do not tend to grow to have the same shoe size as their fathers.
b) Hypothesis: As the cost of a movie ticket increases, the number of people renting DVDs increases. Opposite: As the cost of a movie ticket increases, the number of people renting DVDs does not increase.
c) Hypothesis: As the altitude of a city increases, the length of time to boil water increases. Opposite: As the altitude of a city increases, the length of time to boil water does not increase.
d) Hypothesis: As the age of a university student increases, the average of the student's marks increases. Opposite: As the age of a university student increases, the average of the student's marks does not increase.
3. a) Primary: The Student Council president gathers the data.
b) Secondary: The student uses data from the Internet.
c) Primary: The researcher gathers the data.
d) Secondary: the teacher uses data gathered by Statistics Canada.
4. Answers about advantages will vary.
a) primary; data are up-to-date
b) secondary; Internet search is fast and easy
c) primary; opinions of customers are found
d) secondary; data are accessible
5. Answers will vary. Examples:
a) Most students in the school prefer to spend time rollerblading rather than ice skating in their leisure time.
b) Survey the school. Primary data are best since the population is small and secondary data may not be available.
6. a) Primary: Anoja gathered the data herself.
b) Answers will vary. Examples: Brown-eyed students' favourite subject is History. Most students have blue eyes.
c) Survey a larger sample.
7. a) Secondary: Elliot did not gather the data himself.
b) Answers will vary. Examples:
Most employees who state that their favourite colour is green also state that their favourite animal is a cat. Most employees' favourite animal is a dog.
c) Survey a larger sample.
8. Answers will vary. Examples:
a) The higher the resolution of the camera, the more it will cost.
c) primary if you collect prices from Web sites for individual suppliers; secondary if you find price surveys with data gathered by someone else
d) Visit a camera store to research resolutions and prices.
9. Answers will vary. Example:
a) The higher the altitude of a mountain, the lower the temperature.
10. Answers will vary. Example:
a) The difference between the Olympic records for men and women in the 100-m freestyle swimming race has decreased over the years.

2.2 Sampling Principles, pages 37–38

1. a) all children **b)** all cars
c) all sporting goods stores **d)** all teenagers
2. a) people's heights and weights, sample
b) colours of cars in car dealership, census
c) sizes of painting in Art Gallery, census
d) marks on exam, census
3. Answers will vary. Examples:
a) Survey every fifth student at the school.
b) Randomly select 2% of the teenagers in every high school across Ontario.
c) Select households to survey by any random method, and then ask the people surveyed where they were born.
d) Use a random number generator to select telephone numbers within Ontario and then ask the people in those homes what their favourite TV program is.
4. a) non-random sample; could be biased since Chartered Accountants at this one company may not be representative of all newly qualified Chartered Accountants
b) simple random sample; could be biased since the sample excludes anyone who does not have a telephone listing
c) systemic random sampling
d) non-random sample; biased because it includes only people who have chosen to spend some of their free time going to a museum
5. Answers may vary. Example: by gender, by age, by number of years worked
6. a) all Canadian musicians
b) Answers will vary. Example: Randomly select 15% of the musicians in each province and territory.
7. a) all health club members
b) Answers will vary. Example: Randomly select a starting point on the list of members, and then select every 5th person until you have a total of 100.

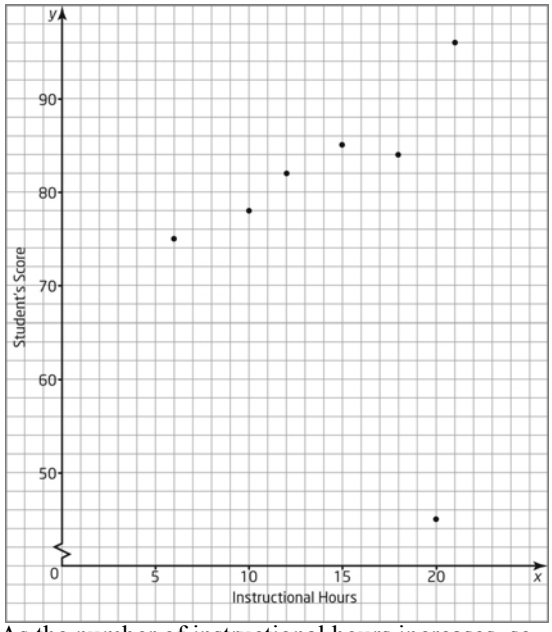
8. a) members of the school clubs
b) Answers will vary. Example: Write each club member's name on a slip of paper, put the slips in a box, and then randomly draw 20% of the slips out of the box.
9. Year 1, 149; Year 2, 133; Year 3, 115; Year 4, 103
10. Sampling techniques will vary. Examples:
a) all students in the school
b) all people in the community
c) all drivers in Canada
d) all teenagers in Ontario
e) all digital imaging companies in Canada
f) propane prices at all vendors in the community
11. Answers will vary.
12. Answers will vary.
13. The sample is representative only of people who are willing to respond to the questions being asked in the survey and then mail back the survey. The sample excludes anyone who does not have the time or does not want to complete the survey.
14. a) Employees at small companies have a greater chance of being selected than employees at large companies.
b) The sample is likely to have a greater proportion of employees from small companies than the population does.

2.3 Use Scatter Plots to Analyse Data, pages 39–40
1. a) independent: physical activity; dependent: heart rate
b) independent: mass of a letter; dependent: cost of postage
c) independent: age of the tree; dependent: height of the tree
d) independent: age of a car; dependent: value of a car
2. a)

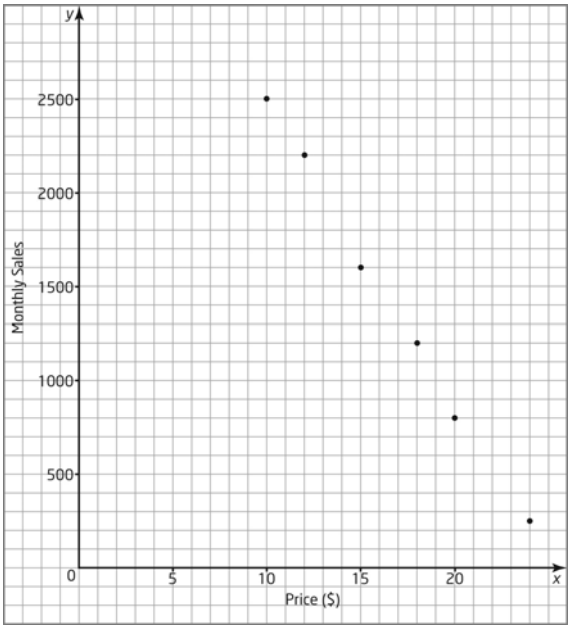


b) As the time increases, so does the value of the mutual fund investment.

3. a) independent: Instructional Hours; dependent: Student's Score
b)

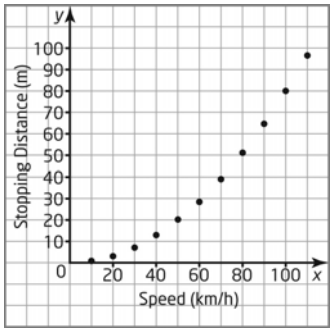


c) As the number of instructional hours increases, so does the student's score.
d) The outlier is (20, 45). The scatter plot indicates a linear correlation, except for this point.
4. a) independent: Price of T-shirt; dependent: Monthly Sales
b)



c) As the price of a T-shirt increases, the monthly sales of T-shirts decrease.
5. a) independent: Speed; dependent: Stopping Distance

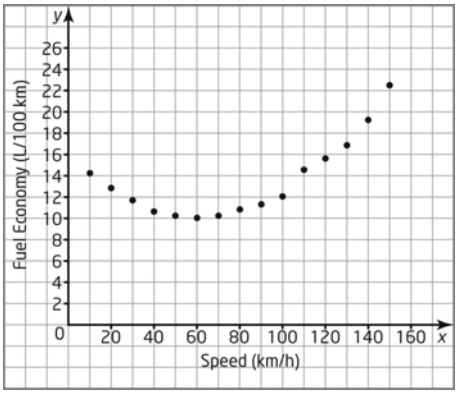
b)



c) As the speed increases, so does the stopping distance.

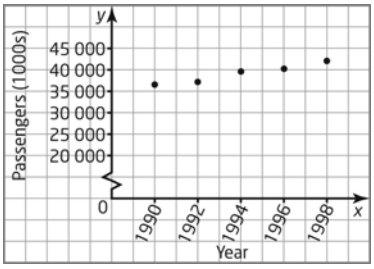
6. a) independent: Speed; dependent: Fuel Economy

b)



c) 60 km/h

7. a)



b) The number of passengers of Canadian air-carriers is increasing.

8. Answers will vary. Examples:

a) As a person's arm length increases, so does the leg length.

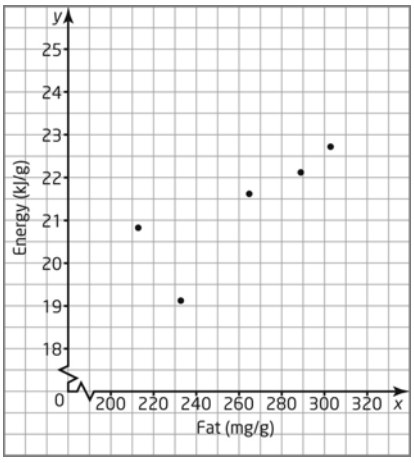
b) Answers will vary. **c)** Answers will vary.

d) Improve accuracy of measurements; use a larger sample.

9. a)

Item	Fat (mg/g)	Energy (kJ/g)
Chocolate Chunk Cookies	265	21.6
Butterfly Wing Cookies	289	22.1
Digestive Biscuits	213	20.8
Pure Butter Shortbreads	303	22.7
Vanilla Wafers	233	19.1

b)

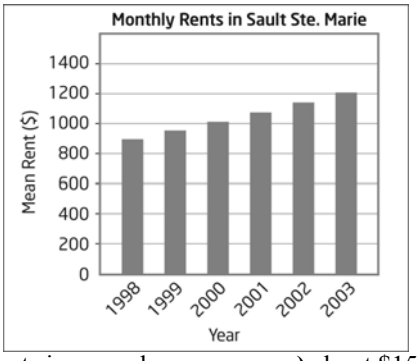


c) The point for Digestive Biscuits is an outlier due to the low fat content. However, this point represents valid data that should not be discarded.

d) Answers will vary. Example: Cookies can have a high energy content without a high fat content.

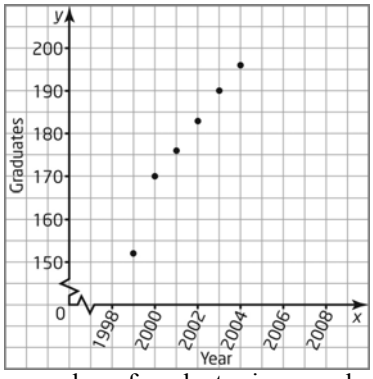
2.4 Trends, Interpolation, and Extrapolation, pages 41–43

1. a)



b) Rents increased every year. **c)** about $1500

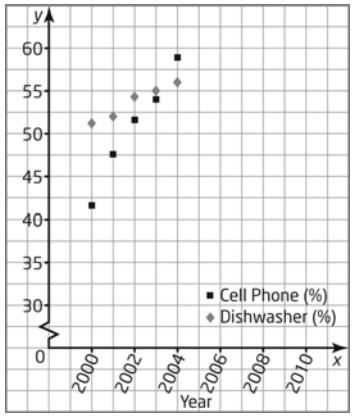
2. a)



b) The number of graduates increased every year.

c) about 223

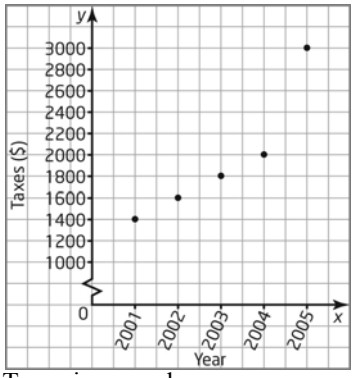
3. a)



b) about 83%; about 64%

4. a) independent: Year; dependent: Taxes

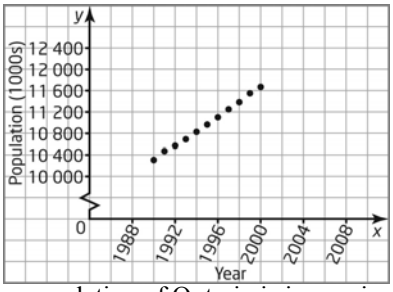
b)



c) Taxes increased every year.

d) (2005, 3000) is an outlier. However, this point represents valid data that should not be discarded.

5. a)



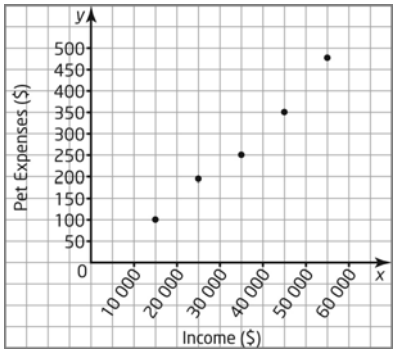
b) The population of Ontario is increasing.

c) 13 000 000

6. a) Graphs will vary. **b)** about 8.1

7. a) independent: income; dependent: pet expenses

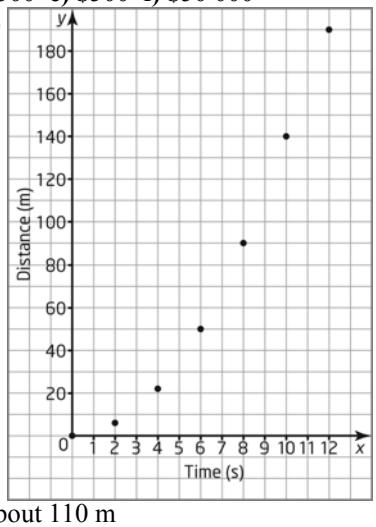
b)



c) As income increases, pet expenses also increase. Reasons for trend may vary. For example, as people earn more, they might buy more expensive pet food or spend more on toys and grooming.

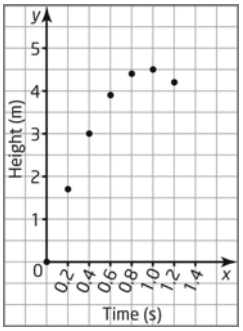
d) $300 **e)** $500 **f)** $50 000

8. a)



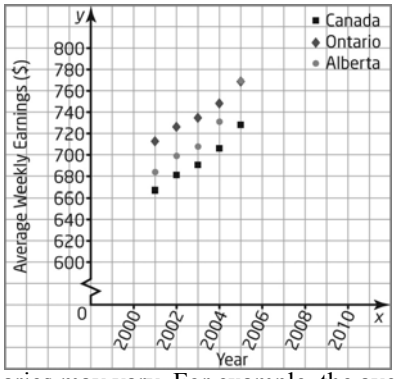
b) about 110 m

9. a)



b) about 2 s

10. a)



Summaries may vary. For example, the average weekly earnings are increasing yearly. The average weekly earnings in Ontario and Alberta are greater than in Canada as a whole. Alberta's weekly earnings are increasing faster than in Ontario and all of Canada.

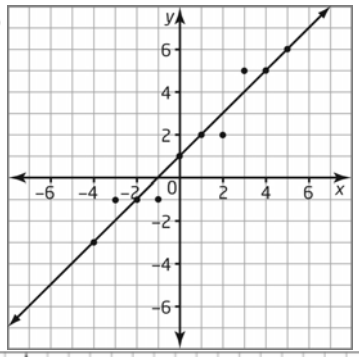
b) Canada, $750; Ontario, $800; Alberta, $800

2.5 Linear and Non-Linear Relations, pages 44–46

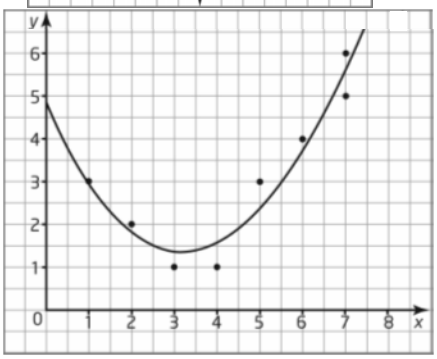
1. a) Yes; the points lie close to a straight line.

b) No; the points lie close to a curve.

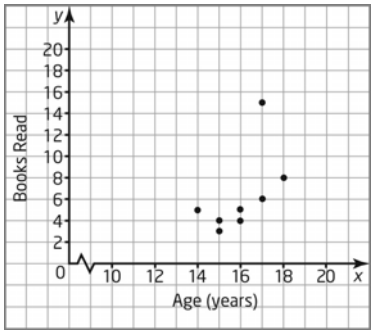
2. a) Linear; the points lie along a straight line.
b) Non-linear; the points lie along a curve.
3. a) No; the points follow a curve.
b) Yes; the points lie close to a straight line.
4. a) No; there is no apparent pattern.
b) No; there are not enough points to find a good line of best fit.
5. a)



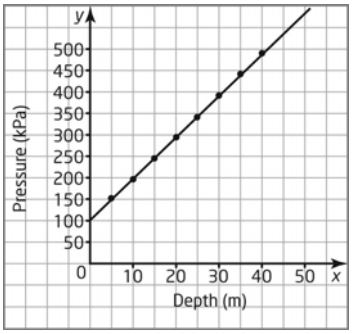
b)



6. a), **b)** Graphs will vary.
c) A non-linear relationship exists between the variables.
7. a)

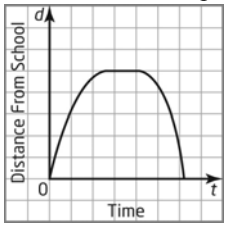


b) A linear relationship exists between the variables if the outlier is ignored.
c) The outlier is the point (17, 15). The scatter plot indicates a linear correlation, except for this point.
8. a), **b)**

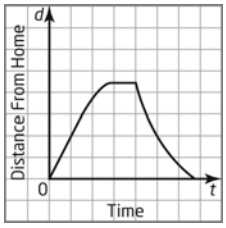


c) As the depth increases, the water pressure increases.
d) 474 kPa **e)** 690 kPa
9. Answers will vary.
10. a) Linear; each time x increases by 1, y increases by 2.
b) Non-linear; h does not change by a constant amount each time t increases by 1.
c) Non-linear; d does not change by a constant amount each time t increases by 1.

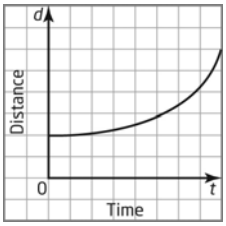
2.6 Distance-Time Graphs, pages 47–48
1. a) moving away at a constant speed
b) no movement
c) moving closer at decreasing speed, then slowing down and stopping
d) moving away at decreasing speed, then slowing down and stopping
2. Answers will vary. Examples:
a) Vaughn walks from school to the library, picks up a library book, and then walks back toward school but stops at a friend's house.
b) Brandon leaves home and runs at a constant speed for 2 min, stops for 1 min, and then walks in the same direction at a constant speed for 5 min.
3. a)



b)

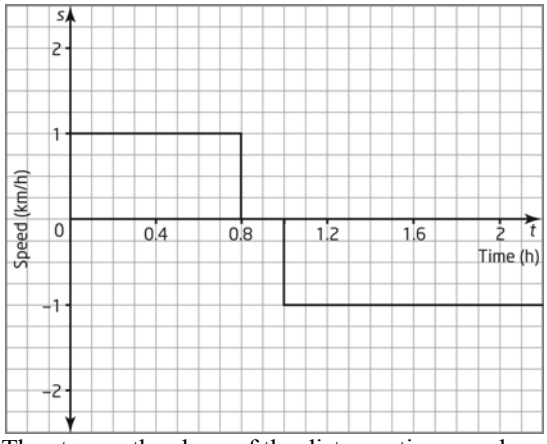


4.



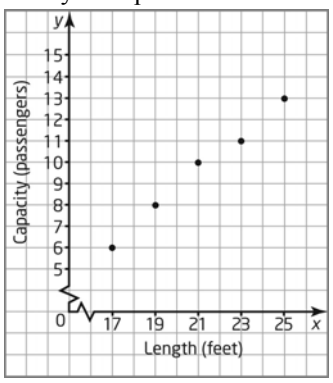
5. a) 2 h **b)** 1 km
c) stopping at the dock directly across the lake
d) on the way to the dock

6. a) Move away from the wall at a constant speed for 2 s, stop for 3 s, and then walk back toward the wall at the same speed for 2 s.
b) The sloped line segments would be steeper.
c) The sloped line segments would be less steep.
7. After starting out, the car increases in speed, and then slows down and stops.
8. a) 1.25 km/h, 0 km/h, 1 km/h
b)

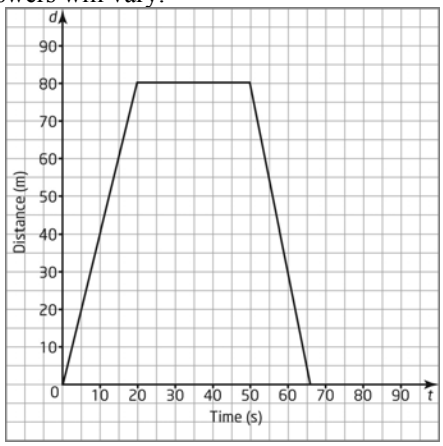


c) The steeper the slope of the distance-time graph, the faster is the speed of the swimmer.
d) the rate at which the swimmer swims back toward the starting dock
9. Answers will vary.

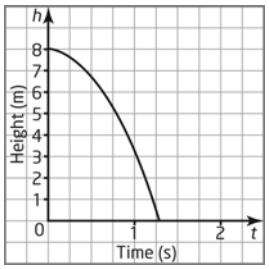
Chapter 2 Review, pages 49–50
1. Answers will vary. Examples:
a) Hypothesis: As the temperature in a city during the winter decreases, the amount of electricity used by the residents increases. Opposite: As the temperature in a city during the winter decreases, the amount of electricity used by the residents does not increase.
b) Hypothesis: Students with larger shoe sizes have higher marks in English. Opposite: Students with larger shoe sizes do not have higher marks in English.
2. a) Internet use has not more than tripled in the last 20 years.
b) If you practise more, your performance in a game will improve or stay the same.
3. a) Primary; a survey of students at the school could give more accurate results than secondary data would.
b) Secondary; primary data could take a lot of time to collect.
4. a) employees working for the chain store
b) Randomly select 15% of the employees in each store.
c) Survey all employees at the nearest store.
d) Employees at the nearest store have the same work conditions. These employees may not have the same concerns and opinions as employees at other stores.
5. a) employees in the office
b) Answers will vary. Example: Randomly select 25% of the employees in each department.
6. a) clients of the travel company
b) Answers will vary. Example: Randomly select one name on a list of the travel agent's clients, and then select every 50th person before and after that name.
7. a)



b) As the length of the boat increases, the capacity also increases. The points follow a line, so the relationship is linear.
c) 9 **d)** 16
8. a) Graphs will vary. The relationship is linear; the points lie close to the line.
b) Graphs will vary. The relation is non-linear; the points follow a curve.
9. Answers will vary.
10. a)



b)



11. a) moving closer at constant speed
b) moving away with increasing speed
c) moving closer at decreasing speed, stopping for moment, and then moving away with increasing speed

12. part a); the points lie on a line.

Chapter 3

3.1 Build Algebraic Models Using Concrete Materials, pages 51–52

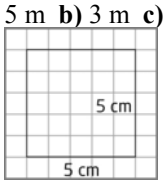
1. Tile models may vary.

2. Tile models may vary.

3. a) $x^2 + 2x + 4$ **b)** $2x^2 + 3x$ **c)** $x^2 + 5$ **d)** $2x + 4$

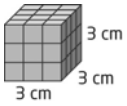
4. a) 5 m **b)** 3 m **c)** 2 m **c)** $3x$ metres **d)** $2x$ metres

5. a)



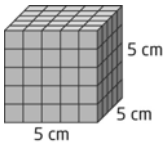
b) 25 cm^2, 5^2 cm^2

6. a)



b) 27 cm^3, 3^3 cm^3

7. a)



b) 125 cm^3, 5^3 cm^3

c) 5^2 cm^2, 25 cm^2

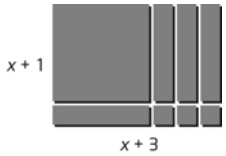
8. a) 8 cm **b)** 512 cm^3, 8^3 cm^3 or 2^9 cm^3

9. a) 150 cm^2 **b)** 294 cm^2

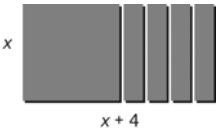
10. a) 16 cm^2 **b)** 4 cm **c)** 64 cm^3, 4^3 cm^3 or 2^6 cm^3

11. a)

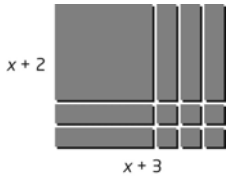
b)



c)



d)



12. a) 2 cm, 4 cm **b)** 120 cm^2

13. 9

3.2 Work With Exponents, pages 53–54

1. a) 5^6 **b)** $(-3)^4$ **c)** 2.03^5 **d)** $\left(-\frac{2}{3}\right)^3$

2. a) $2 \times 2 \times 2 \times 2$

b) $(-4) \times (-4) \times (-4) \times (-4) \times (-4)$

c) $0.7 \times 0.7 \times 0.7$ **d)** $\left(-\frac{3}{4}\right) \times \left(-\frac{3}{4}\right)$

3. a) 8 **b)** 16 **c)** −16 **d)** −216 **e)** $\frac{81}{256}$

4. a) $-\frac{8}{27}$ **b)** 12.167 **c)** 1 **d)** −1 **e)** −1

5. a) 24 **b)** 960 **c)** 256 **d)** 1

6. a) 12 **b)** 20 **c)** 32 **d)** $-\frac{1}{6}$ **e)** 240 **f)** −45

7. a) 45 **b)** 19.6 **c)** 144 **d)** 150.8 **e)** 18.1 **f)** 0

8. a) 3, 9, 27, 81, 243, 729

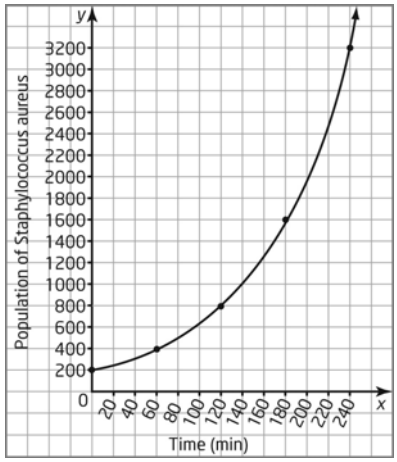
b) The final digits are in the sequence 3, 9, 7, 1, 3, 9, ….

c) 7

9. a)

Time (min)	Population of Staphylococcus aureus
0	200
60	400
120	800
180	1600
240	3200

b)

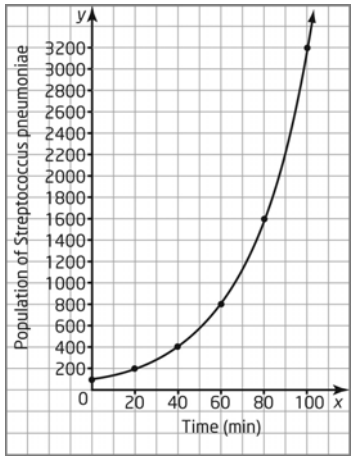


c) 819 200, 3 355 443 200

10. a)

Time (min)	Population of Streptococcus pneumoniae
0	100
20	200
40	400
60	800
80	1600
100	3200

b)

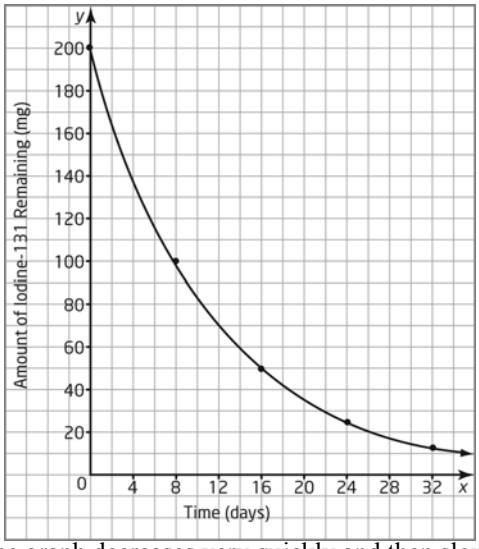


11. a) 5 000 000 **b)** 5 000 000

12. a)

Number of Half-Life Periods	Time (days)	Amount of Iodine-131 Remaining (mg)
0	0	200
1	8	$200\left(\frac{1}{2}\right)^1 = 100$
2	16	$200\left(\frac{1}{2}\right)^2 = 50$
3	24	$200\left(\frac{1}{2}\right)^3 = 25$
4	32	$200\left(\frac{1}{2}\right)^4 = 12.5$

b)



The graph decreases very quickly and then slows down as it gets closer to 0.
c) 3.125 mg **d)** 61 days
13. a) 3.45×10^{10} **b)** 5.12×10^{-9}

3.3 Discover the Exponent Laws, pages 55–56

1. a) $4^5 = 1024$ **b)** $(-2)^6 = 64$ **c)** $2.5^6 = 244.140\,625$
d) $(-1)^{40} = 1$ **e)** $\left(\frac{2}{3}\right)^7 = \frac{128}{2187}$ **f)** $\left(-\frac{3}{5}\right)^5 = -\frac{243}{3125}$
2. a) $8^2 = 64$ **b)** $(-5)^3 = -125$ **c)** $3.2^3 = 32.768$
d) $(-1)^{15} = -1$ **e)** $\left(\frac{3}{4}\right)^3 = \frac{27}{64}$ **f)** $\left(-\frac{2}{5}\right)^2 = \frac{4}{25}$
3. a) $5^6 = 15\,625$ **b)** $(-4)^6 = 4096$
c) $(0.2)^6 = 0.000\,064$ **d)** $(-1)^{18} = 1$ **e)** $\left(\frac{1}{5}\right)^4 = \frac{1}{625}$
f) $\left(-\frac{5}{6}\right)^6 = \frac{15\,625}{46\,656}$
4. a) $3^7 = 2187$ **b)** $4^2 = 16$ **c)** $2^{12} = 4096$ **d)** $2^2 = 4$
5. a) $3^3 = 27$ **b)** $4^5 = 1024$ **c)** $0.2^3 = 0.008$
d) $(-3)^1 = -3$ **e)** $6^{10} = 60\,466\,176$ **f)** $(-5)^4 = 625$
6. a) x^8 **b)** y^2 **c)** m^{12} **d)** d^8 **e)** a^4b^4 **f)** c^4d^3
7. a) $15x^7y^5$ **b)** $2a^4b$ **c)** $m^{10}n^6$ **d)** $-8c^9$
8. a) $2dm^4$ **b)** g^3h^4 **c)** xy^4
9. a) 8 **b)** $2x^2y^2$; 8 **c)** Answers will vary.
10. a) $\frac{1}{512}, \frac{1}{4096}$
b) $\left(\left(\frac{1}{2}\right)^3\right)^3$; Answers may vary for 12 tails in a row: possibilities are $\left(\left(\frac{1}{2}\right)^2\right)^6$, $\left(\left(\frac{1}{2}\right)^3\right)^4$, $\left(\left(\frac{1}{2}\right)^4\right)^3$, and $\left(\left(\frac{1}{2}\right)^6\right)^2$.
11. a) $\frac{1}{6}$ **b)** $\frac{1}{7776}$ **c)** $\frac{1}{2}$ **d)** $\frac{5}{6}$
12. a) $\frac{1}{4}$ **b)** $\left(\frac{1}{4}\right)^4 = \frac{1}{256}$ **c)** $\left(\frac{1}{4}\right)^7 = \frac{1}{16\,384}$
13. a) $8 \times 10^7 = 80\,000\,000$ **b)** $7 \times 10^5 = 700\,000$
c) $2 \times 10^4 = 20\,000$ **d)** $2.3 \times 10^2 = 230$
14. $x^2, x, \frac{1}{x}, \frac{1}{x^2}$
15. a) Answers will vary. **b)** Answers will vary.

3.4 Communicate With Algebra, pages 57–59

1. a) coefficient: 3, variable x
b) coefficient: −5, variable: y
c) coefficient: 1, variable: dm
d) coefficient: −4, variable: ab
2. a) coefficient: −1, variable: w^3y^2
b) coefficient: −0.2, variable: e^5f
c) coefficient: $\frac{2}{3}$, variable: x^5
d) coefficient: $-\frac{3}{8}$, variable: y^4
3. a) monomial **b)** binomial **c)** trinomial
d) monomial **e)** trinomial **f)** binomial
4. a) 1 **b)** 3 **c)** 1 **d)** 8 **e)** 4 **f)** 8 **g)** 0 **h)** 0
5. a) 1 **b)** 2 **c)** 3 **d)** 9 **e)** 5 **f)** 8
6. $2w + t$
7. a) Variable chosen may vary; c **b)** $0.45c$
c) \$9 **d)** \$6300
8. a) $2b + f$, where b represents the number of baskets and f represents the number of free throws.
b) 17
9. a) $c - 2i$, where c represents the number of correct answers and i represents the number of incorrect answers.
b) 16
10. a) $10g + 5s$

b)

Term	Variable	Coefficient	Meaning
$10g$	g	10	g: number of gold memberships she sells 10: bonus she gets per membership
$5s$	s	5	s: number of silver memberships she sells 5: bonus she gets per membership

c) \$350

11. a) $80o + 50d + 25b$

b)

Term	Variable	Coefficient	Meaning
$80o$	o	80	o: the number of orchestra seats sold 80: the earnings per orchestra seat
$50d$	d	50	d: the number of dress circle seats sold 50: the earnings per dress circle seat
$25b$	b	25	b: the number of balcony seats sold 25: the earnings per balcony seat

c) \$21 750 **d)** \$23 900

12. a) $400 + 0.15v + 200p$, where v represents the value of the boat and p represents the number of passengers.

b) \$30 400

13. a) Answers will vary. For example: s: swim, c: cycle, r: run

b)

Part of the Race	Speed (km/h)	Distance (km)	Time (h)
swim	1.5	s	$\frac{s}{1.5}$
cycle	30	c	$\frac{c}{30}$
run	12	r	$\frac{r}{12}$

c) $\frac{s}{1.5}+\frac{c}{30}+\frac{r}{12}$ **d)** 12 h 3 min 24 s

3.5 Collect Like Terms, pages 60–61

1. a) like **b)** unlike **c)** unlike **d)** like **e)** like **f)** unlike

2. Answers will vary

3. $5x$ and $-3x$, $-3mn$ and $5mn$, 8 and -5, $4a^5$ and $7a^5$, $-2x^3$ and $2x^3$, and $6a^2b^2$ and $-3a^2b^2$

4. a) $8x + 6$ **b)** $2y + 2$ **c)** $3m + 1$ **d)** $n - 6$ **e)** $5x^2 + 9$ **f)** $3a - 2b$

5. a) $7x^2 + 7x$ **b)** $2a - 2$ **c)** $2m^2 - 2m - 1$ **d)** $4w^3 + 6w^2 - w$

6. a) $a^2 - 3ab - b^2$ **b)** $m^3n^2 + m^2n^3$ **c)** $-7x^2y - 3x + 2$ **d)** $7r^4 + r^2 - 3$

7. a) $2(w + 5w)$ or $2(6w)$ or $12w$, where w is the width of the garden

b) 240 m **c)** width: 15 m; length: 75 m **d)** $5w^2$ **e)** 4500 m^2 **f)** width: 10 m; length: 50 m

8. Diagrams may vary.

a) $6x + 4$ **b)** $2y + 1$ **c)** $6c^2 - c$

9. a) $4x$ **b)** x^2 **c)** 20 m

10. a)

Store	Profit (\$)	Profit (or Loss) After 2 Months (\$)
North End	$1500x - 3200$	–200
South End	$1300x - 900$	1700
West End	$2150x - 1100$	3200
East End	$1700x - 5000$	–1600
Central	$1850x - 800$	2900

\$6000

b) $8500x - 11\,000$ **c)** \$6000; the same **d)** \$91 000

11. $5x$

12. a) John multiplied the like terms instead of adding them.

b) Answers will vary. Example: Substitute any value for x into the original expression and into the simplified expression.

c) $2x^2 + 5x$. Verify by substituting a value for x into the expressions.

13. 1806

3.6 Add and Subtract Polynomials, pages 62–64

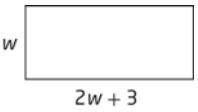
1. a) $8x + 5$ **b)** $10m - 1$ **c)** $-2n + 1$ **d)** $10k + 9$ **e)** $13r + 2$

2. a) $x + 2$ **b)** $4m + 1$ **c)** $2s - 7$ **d)** $2d - 2$ **e)** $r + 12$ **f)** $3t - 12$

3. a) $7x + 2$ **b)** $12y - 7$ **c)** $6p^2 + 5p - 2$ **d)** $5m^2 - 6mn - n^2$ **e)** $3a + 3b$ **f)** $5p^2 + p + 3q$

4. a) $180\,000 + 170b$ **b)** \$231 000

5. a)



b) $6w + 6$

c) $w(2w + 3)$

d) 18 m; 14 m^2

6. a) $120\,000 + 0.6n$

b) silver status: \$150 000, gold status: \$165 000, platinum status: \$180 000

c)

Status	Employee
silver	Susan and Kelvin
gold	Kelvin
platinum	Kelvin

7. missing expressions: step 2: $-4x - 5y$; step 3: $-6x - 4y$

8. missing expressions: step 2: $-x - 3y$; step 3: $3x + 7y$

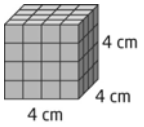
9. a) Cruz: $80\,000 + 35g + 25a$; Gortan: $60\,000 + 20g + 18a$; McKinnon: $100\,000 + 42g + 30a$

b) 240 000 + 97g + 73a **c)** $266 700
10. a) Jack: $1200; Yaling: $1 050; Stacia: $1125; Meisrain: $1325; Janet: $1250
b) 4050 + 38 000c

3.7 The Distributive Property, pages 65–66

1. a) $3x + 6$ **b)** $4x - 20$ **c)** $-2x - 8$ **d)** $-5x + 20$
2. a) $8a + 12$ **b)** $18b - 24$ **c)** $-6m - 5$ **d)** $-4r + 3$
3. a) $x^2 + 4x$ **b)** $a^2 - 5a$ **c)** $-z^2 + 3z$ **d)** $-2b^2 + b$
4. a) $-3w^2 - 5w$ **b)** $-3m^2 + 2m$ **c)** $12q^2 + 28q$
d) $14d^2 + 35d$
5. a) $3m + 6$ **b)** $5d - 15$ **c)** $-6h - 10$ **d)** $-12r + 3$
6. a) $5q - 20$ **b)** $7b - 42$ **c)** $-20t - 28$ **d)** $-35c + 15$
7. a) $3x^2 + 15x + 12$ **b)** $5x^2 - 15x + 10$
c) $4m^3 + 12m^2 + 20m$ **d)** $5a^3 + 5a^2 - 20a$
e) $3x^2 + 21x + 9$
8. a) $-4x^2 - 4x + 4$ **b)** $5a^2 - 5a + 20$ **c)** $-r^2 - r + 5$
d) $20x + 30$ **e)** $-16b + 60$
9. a) $8x + 2$ **b)** $a - 23$ **c)** $1.3c - 1.9$ **d)** $-22d + 4$
e) $7k^2 + 3k$
10. a) 75 +25t, where t is the time, in hours.
b) $162.50 **c)** 150 + 50$t$
d) $325. Yes, the answer makes sense because it is doubled.
11. a) $-1.8h^2 - 0.1h$ **b)** $6a - 17$ **c)** $3r - 28$
d) $10a^2 + 17a - 16$ **e)** $4g^2 - 3g - 9$
12. a) $14x + 6$ **b)** $12x^2 + 9x$
c) Perimeter: $28x + 12$, Area: $48x^2 + 36x$
d) Yes. Double the old perimeter is $2(14x + 6)$ or $28x + 12$.
e) No. Double the old area is $2(12x^2 + 9x)$ or $24x^2 + 18x$, which is not equal to the new area.
13. $SA = 2lw + 2hw + 2lh$
14. a) $4x + \frac{17}{12}$ **b)** $-4a + \frac{23}{20}b$ **c)** $4m + \frac{26}{15}$
d) $a - \frac{23}{6}c$
15. a) $15x^2 + 24x$ **b)** $4m^2 + 40m$ **c)** $2a^3 + 30a^2$
d) $-14b + 10$ **e)** $-y - 13$ **f)** $-5c - 5$
16. a) $x^2 + 7x + 12$ **b)** $a^2 + 11a + 30$ **c)** $b^2 + 10b + 21$
d) $w^2 + 10w + 16$ **e)** $d^2 + 3d - 10$
17. a) $z^2 - 3z - 18$ **b)** $m^2 + m - 20$ **c)** $y^2 - 2y - 15$
d) $h^2 - 12h + 32$ **e)** $p^2 - 6p + 9$
18. a) $x^3 + 5x^2 + 10x + 8$ **b)** $y^3 - y^2 - 17y - 15$

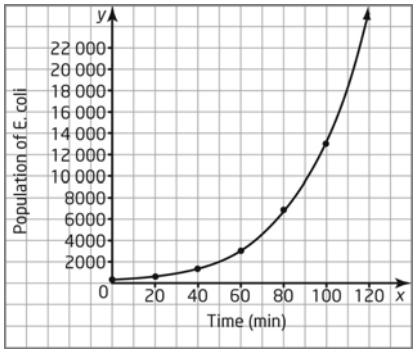
Chapter 3 Review, pages 67–68

1. Models will vary. **a)** 5 **b)** $3x$ **c)** $x + 5$ **d)** 2
2. a) 

b) 64 cm^3; 4^3 cm^3
c) 4^2 cm^2, 16 cm^2
d) 6(4^2) cm^2; 96 cm^2
3. a) 125 **b)** 64 **c)** $\frac{27}{64}$ **d)** 1.338 225 557 8
4. a) $3^6 = 729$ **b)** $5^3 = 125$ **c)** $4^3 = 64$ **d)** $2^4 = 16$
e) $(-3)^6 = 729$ **f)** $5^3 = 125$

5. a)

Time (min)	Population of E. coli
0	400
20	800
40	1 600
60	3 200
80	6 400
100	12 800
120	25 600

b)


c) 13 107 200; 6 710 886 400
6. a) a^8b^6 **b)** d^4 **c)** m^2 **d)** y^8
7. a) coefficient: 6, variable: x
b) coefficient: −5, variable: y
c) coefficient: 7, variable: none
d) coefficient: 4, variable: a^5b^3
e) coefficient: 1, variable: dm
f) coefficient: $\frac{2}{3}$, variable: x^2y^3
8. a) $4w + 2o$, where w represents a win and o represents an overtime win. **b)** 24
9. a) 4 **b)** 5 **c)** 6 **d)** 0
10. a) 1 **b)** 4 **c)** 2 **d)** 3
11. a) like **b)** unlike **c)** like **d)** unlike **e)** like
f) like
12. a) $6x^2$, $-5x^2$ **b)** $6y^2$, $5y^2$, $-4y^2$; $-4y^3$, $-2y^3$
13. a) $7x + 11y$ **b)** $d - 2m$ **c)** $a^2 - 3a - 3$
d) $w^2 + 3y^2$ **e)** $7d - 3e - 16f$ **f)** $11a^3 - 7ab + 5b^2 - 3$
14. a) $11x - 1$ **b)** $9y - 5$ **c)** $10p^2 + p + 1$
d) $3m^2 - 4mn + 3n^2$ **e)** $4a + 7b$
15. $14x + 4$
16. a) $5x + 10$ **b)** $-4y + 12$ **c)** $6m^2 + 8m$
d) $-8g^2 + 12g$
17. a) $23x + 42y$ **b)** $6y - 6w - 3$ **c)** $17a - 3b$
d) $24c + 28$

Chapter 4

4.1 Solve Simple Equations, pages 69–70

1. a) $x = 3$ **b)** $y = 8$ **c)** $m = 3$ **d)** $c = 6$
2. a) $x = 4$ **b)** $y = 6$ **c)** $a = 5$ **d)** $b = 20$
3. a) $x = 3$ **b)** $g = 2$ **c)** $h = 7$ **d)** $c = -2$
4. a) $d = -7$ **b)** $k = 3$ **c)** $u = -4$ **d)** $w = -10$
5. a) $x = 2$ **b)** $w = 2$ **c)** $p = 4$ **d)** $h = -1$
6. a) $q = 2$ **b)** $a = 13$ **c)** $m = 2$ **d)** $b = 1$
7. a) $a = -10$ **b)** $c = 7$ **c)** $d = 5$ **d)** $h = -15$

8. a) $r = 7$ **b)** $v = -1$ **c)** $g = 1$ **d)** $j = -4$
9. The variable used may vary.
a) $15d = 120$ **b)** $d = 8$
10. a) $h = \frac{2}{3}$ **b)** $k = \frac{1}{5}$ **c)** $w = \frac{5}{7}$
11. a) $d = -\frac{1}{2}$ **b)** $r = -\frac{22}{15}$ **c)** $t = \frac{14}{15}$
12.

Step	Explanation
$5x - 4 = 6$	
$5x - 4 + 4 = 6 + 4$	Add 4 to both sides.
$5x = 10$	Simplify by adding integers.
$\frac{5x}{5} = \frac{10}{5}$	Divide both sides by 5.
$x = 2$	Divide integers to give the solution for x.

13. a) $a = 30°$, $b = 60°$, $c = 90°$
b) $a = 20°$, $b = 60°$, $c = 100°$
14. The variable used may vary.
a) $15n + 250 = 2000$
b) $n = 116.\overline{6}$; The committee can afford 116 T-shirts.
15. a) $2000 + 840n = 10\,400$, where n is the number of litres.
b) 10 L

4.2 Solve Multi-Step Equations, pages 71–72

1. a) $x = 2$ **b)** $y = 3$ **c)** $a = -3$ **d)** $m = 4$
2. a) $w = 5$ **b)** $k = -2$ **c)** $b = 1$ **d)** $d = -3$
3. a) $t = -5$ **b)** $c = -5$ **c)** $x = 2$ **d)** $n = 1$
4. a) $x = -3$ **b)** $q = 4$ **c)** $t = 7$ **d)** $u = 4$
5. a) $r = 2$ **b)** $y = \frac{15}{2}$ **c)** $v = -4$ **d)** $y = 2$
6. $x + 4x = 180°$, where x is the measure of the smaller angle, in degrees; 36°, 144°
7. 10°, 30°, 50°
8. a) $x = \frac{5}{3}$ **b)** $h = -\frac{3}{2}$ **c)** $m = -4$ **d)** $p = -13$
9. equilateral triangle: 8, 8, 8; rectangle: 7 by 5
10. 108°, 36°, 36°
11.

Step	Explanation
L.S. = $3(x + 4) + 6$	
$= 3[(-3) + 4] + 6$	Substitute the root into the left side.
$= 3(1) + 6$	Simplify the expression inside the brackets.
$= 3 + 6$	Multiply.
$= 9$	Add.
R.S. = $9 - (x + 3)$	
$= 9 - [(-3) + 3)$	Substitute the root into the right side.
$= 9 - (0)$	Simplify the expression inside the brackets.
$= 9$	Subtract.

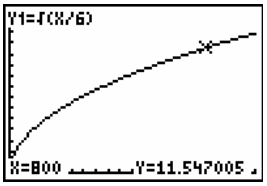
12. a) 20 cm, 20 cm, 30 cm
b) The perimeter is the sum of the sides and this must be 70 cm. So, write and solve the equation $2x + 2x + 3x = 70$.
13. 1350 cm^2
14. a) $x = -12$ **b)** $k = -\frac{10}{3}$ **c)** $m = \frac{1}{4}$ **d)** $d = \frac{3}{5}$

4.3 Solve Equations Involving Fractions, pages 73–74

1. a) $x = -5$ **b)** $a = -3$ **c)** $m = 8$
2. a) $k = 2$ **b)** $k = 5$ **c)** $p = 4$
3. a) $y = -7$ **b)** $p = -17$ **c)** $h = \frac{7}{4}$
4. a) $n = -\frac{1}{2}$ **b)** $c = -5$ **c)** $w = -11$
5. a) $h = 9$ **b)** $d = -10$ **c)** $x = -7$
6. a) $p = 15$ **b)** $k = -37$ **c)** $s = 12$
7. a) $m = \frac{59}{9}$ **b)** $k = \frac{5}{2}$ **c)** $c = -\frac{13}{14}$ **d)** $n = \frac{7}{5}$
e) $w = 17$
8. 12 m
9. a) The error is in the second line, $4(x + 5) = 3(x - 2)$. The numerators on each side of the first line were multiplied by their own denominators. The correct step should be to multiply both sides by 12 (the lowest common denominator).
b) The third line is incorrect. In the previous line, the denominators and the 10 were eliminated instead of being simplified. The third line should be $2(2y + 4) = 5(y - 3)$.
10. 18 cm
11. a) 86°F **b)** 25°C
12. a) $a = \frac{3}{2}$ **b)** $u = -\frac{18}{11}$ **c)** $w = \frac{57}{29}$
13. a) height 4.0 m; base 2.0 m **b)** 4 m^2

4.4 Modelling With Formulas, pages 75–76

1. a) $d = \frac{C}{\pi}$ **b)** $t = \frac{d}{v}$ **c)** $I = A - P$
2. a) $m = \frac{y - b}{x}$ **b)** $y = \frac{-Ax - C}{B}$ **c)** $a = \frac{F}{m}$
d) $R = \frac{V}{I}$
3. a) $s = \sqrt[3]{V}$ **b)** $R = \frac{P}{I^2}$ **c)** $h = \frac{V}{\pi r^2}$
4. a) $l = \frac{P - 2w}{2}$ **b)** $s = \sqrt{A}$ **c)** $h = \frac{2A}{b}$
d) $a = \sqrt{c^2 - b^2}$
5. a) 6.6 pounds; 1.1 pounds **b)** $w = \frac{m}{2.2}$
c) 3.6 kg

6. a) 

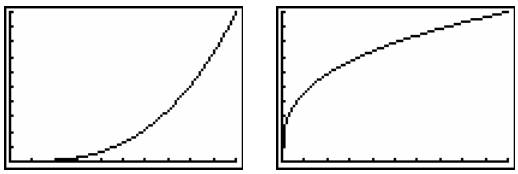
b) Linear. When the equation is graphed, a straight line results.
c) 1.4 kg; 11 pounds

7. a) $s = \sqrt{\frac{A}{6}}$ **b)** 11.5 cm

8. a) <<tech art 2-Chapter 4 Answers>>; 11.5 cm
b) Non-linear. Since the graph is curved, the relation is non-linear.

9. $r = \frac{I}{Pt}$, $t = \frac{I}{Pr}$

10. a) $s = \sqrt[3]{V}$

b) 

c) Answers will vary. Both graphs show a non-linear relationship.
d) Answers will vary. In the first graph, $V = s^3$, the graph opens upward. In the second graph, $s = \sqrt[3]{V}$, the graph opens sideways.

11.

Step	Explanation
$F = \frac{Gm_1m_2}{d^2}$	Start with the original formula.
$Fd^2 = Gm_1m_x$	Multiply both sides of the equation by d^2.
$\frac{Fd^2}{F} = \frac{Gm_1m_2}{F}$	Divide both sides of the equation by F.
$d^2 = \frac{Gm_1m_2}{F}$	Simplify.
$\sqrt{d^2} = \sqrt{\frac{Gm_1m_2}{F}}$	Take the square root of both sides.
$d = \sqrt{\frac{Gm_1m_2}{F}}$	Simplify to isolate d.

4.5 Modelling With Algebra, pages 77–78

1. a) $4n$ **b)** $n + 3$ **c)** $\frac{1}{3}n$ **d)** $3n - 4$

2. a) $5n$ **b)** $2n + 6$ **c)** $n - 2$ **d)** $\frac{3}{5}n$

3. a) $5n = 85$; the variable n represents any number
b) $a + 8 = 177$; the variable a represents the area
c) $2n + 3 = 33$; the variable n represents any number
d) $x - 1 + x + x + 1 = 168$; the variable x represents any number

4. a) 17; this represents the number that equals 85 when multiplied by 5
b) 169; this represents the area that when increased by 8 equals 177
c) 15; this represents the number that, when multiplied by 2, is three less than 33
d) 56; the sum of this number and the two numbers on either side, 55 and 57, is 168

5. Natasha: 565; Krysten: 315
6. Justin: $57.50; Kieran: $37.50
7. Jacinth: 17; Naomi: 13
8. $8000
9. 39, 40, 41
10. a) length = 20 m; width = 10 m **b)** 60 m
c) 22.4 m
11. Jessica: 20; Letitia: 40; Sally: 48
12. a) $8.5t + 2m$, where t represents the time, in hours, and m represents the number of memberships.
b) $145 **c)** 195 **d)** 20 h
13. Azra, $85; Anoja, $170; Amani, $195
14. Alicia: 534 coins; Wayne 178 coins
15. front width: 9 m; back width: 3 m
16. triple the height
17. a) $E = 7.5t + 0.75g$, where E represents the earnings, in dollars; t represents the time, in hours; and g represents the number of pairs of sunglasses.
b) $63.75 **c)** 40

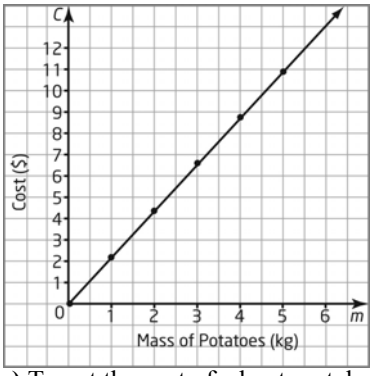
Chapter 4 Review, pages 79–80

1. a) $x = 4$ **b)** $f = 10$ **c)** $h = 5$ **d)** $k = 12$
2. a) $x = 3$ **b)** $y = -1$ **c)** $f = -11$ **d)** $m = -3$
3. a) $x = 2$ **b)** $p = -1$ **c)** $w = -\frac{1}{3}$ **d)** $u = \frac{3}{4}$
4. a) $5.95 + 2.95m = 23.65$, where m represents the number of magazines John can afford.
b) $m = 6$
5. a) $x = 3$ **b)** $c = 4$ **c)** $r = -5$ **d)** $g = -2$
6. a) $a = -1$ **b)** $b = 6$ **c)** $n = 6$ **d)** $d = -2$
7. 10°, 50°, 120°
8. a) $x = 7$ **b)** $b = 26$ **c)** $m = \frac{21}{2}$ **d)** $d = -\frac{19}{3}$
9. a) $r = 1$ **b)** $p = \frac{14}{5}$ **c)** $q = -7$ **d)** $b = \frac{7}{2}$
10. a) $x = 32$ **b)** $y = 26$ **c)** $b = -17$ **d)** $v = -27$
11. a) $m = \frac{F}{a}$ **b)** $I = \frac{V}{R}$ **c)** $r = \sqrt{\frac{A}{\pi}}$ **d)** $w = \frac{P - 2l}{2}$
e) $x = \frac{y - b}{m}$
12. a) 200 W **b)** 4 Ω **c)** 30 V

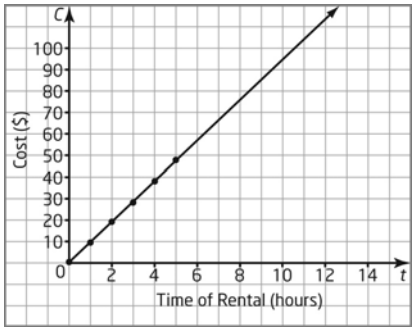
13. Suresh: 13 years; Hakima: 26 years; Saad: 9 years
14. a) \$49.50 **b)** 64
15. a) \$52.20 **b)** 100 **c)** 80

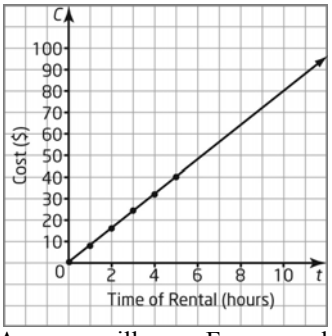
Chapter 5
5.1 Direct Variation, pages 81-82
1. a) 90 **b)** 15 **c)** 8
2. a) $C = 75w$
b) the cost per 1 m of width for the patio **c)** \$525
3. a)

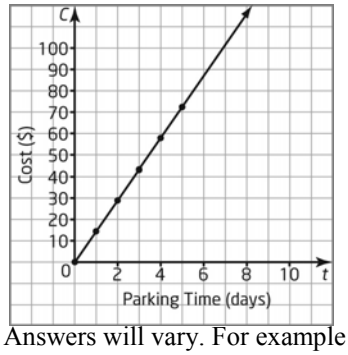
Mass of Potatoes, m (kg)	Cost, C (\$)
0	0.00
1	2.18
2	4.36
3	6.54
4	8.72
5	10.90

b) 

c) $C = 2.18m$

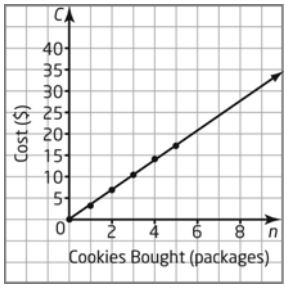
4. a) To get the cost of a boat rental, multiply the time the boat is rented, in hours, by \$9.50. The cost, C, in dollars, of renting the boat varies directly with the time, t, in hours, for which the boat is rented.
b) 

$C = 9.5t$
c) Answers will vary. Example: about \$110. **d)** \$114
5. a) To get the cost of a rental, multiply the time, in hours, rented by \$8. The cost, C, in dollars, of renting, varies directly with the time, t, in hours, for which the canoe is rented.
b) 

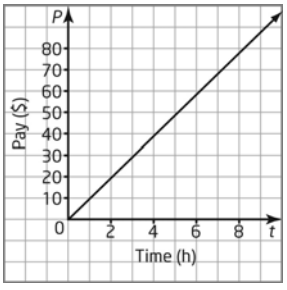
$C = 8t$
c) Answers will vary. For example: \$60. **d)** \$64
6. a) To get the cost of parking, multiply the time, in days, parked by \$14.50. The cost, C, in dollars, of parking, varies directly with the time, t, in days, for which the vehicle is parked.
b) 

$C = 14.5t$
c) Answers will vary. For example: \$90. **d)** \$87
7. a)

Cookies Bought, n (packages)	Cost, C (\$)
0	0.00
1	3.50
2	7.00
3	10.50
4	14.00

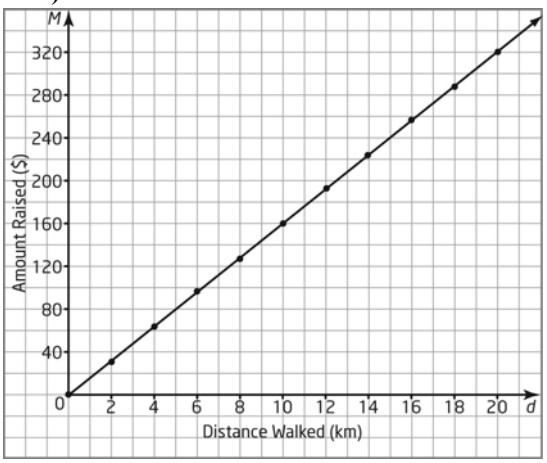
b) 

c) $C = 3.50n$

8. a) This relationship is a direct variation because the pay that Alison receives varies directly with the time she works.
b) $P = 9.75t$ **c)** 

9. Answers will vary. Example: Consider the cost, in dollars, of taking a taxi for a certain distance, in kilometres.

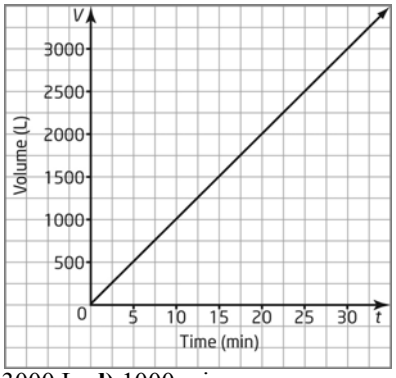
10. a)



b) $M = 16d$ **c)** $400

11. a) $V = 100t$, where V is the volume of water, in litres, and t is the time, in minutes. The constant of variation represents the constant average rate of change of volume: 100 L/min.

b)



c) 3000 L **d)** 1000 min

12. $l = 0.220g$, where l is the number of litres and g is the number of Canadian gallons.

5.2 Partial Variation, pages 83–84

1. a) Direct variation: the equation is of the form $y = kx$.

b) Partial variation: the equation is of the form $y = mx + b$.

c) Partial variation: the equation is of the form $y = mx + b$

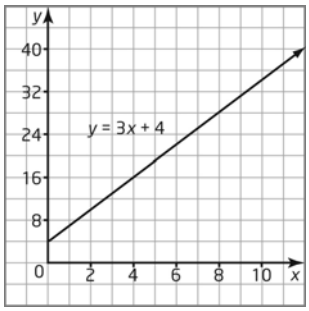
d) Direct variation: the equation is of the form $y = kx$.

2. a)

x	y
0	4
1	7
2	10
3	13
4	16
7	25

b) 4, 3 **c)** $y = 3x + 4$

d)



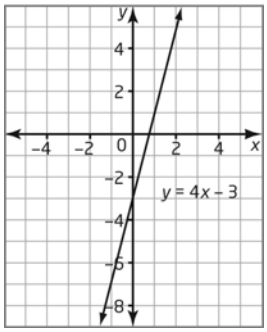
e) The graph is a straight line that intersects the y-axis at (0, 4). The y-values increase by 3 as the x-values increase by 1.

3. a)

x	y
0	−3
1	1
2	5
3	9
4	13
8	29

b) −3, 4 **c)** $y = 4x - 3$

d)

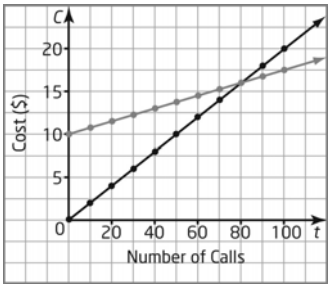


e) The graph is a straight line that intersects the y-axis at (0, −3). The y-values increase by 4 as the x-values increase by 1.

4. a) $200, $3 × number of people

b) $C = 3n + 200$ **c)** $500

5. a)



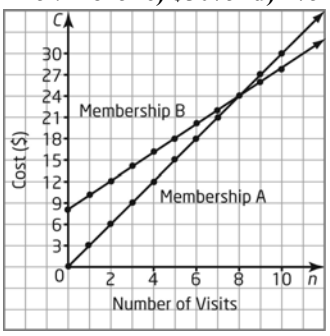
b) A: direct variation; B: partial variation

c) In both cases, C represents the cost of the cellular phone plan and n represents the number of calls.
A: $C = 1.50n$; B: $C = 0.25n + 25$

d) Plan A is cheaper when fewer than 20 phone calls are made. Plan B is cheaper when more than 20 phone calls are made.

6. a) The fixed cost is $50 and could represent, for example, the cost of paper, ink, and overhead.

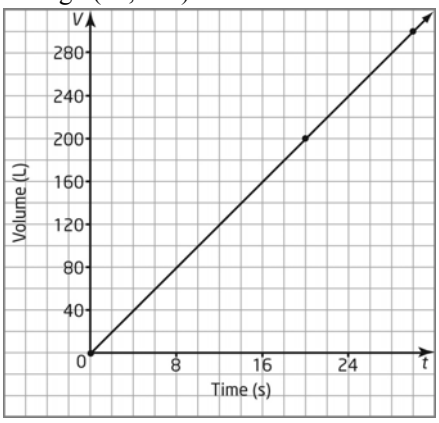
b) From the table, it costs \$400 to print 200 newsletters, so the variable cost to print one newsletter is \$400 ÷ 200 = \$2.
c) $C = 2n + 50$ **d)** \$2450 **e)** 125
7. Answers will vary. Example: Consider the cost of renting a truck for a day. It costs a \$50 flat fee and \$0.50 per km.
8. a) fixed cost: \$825; variable cost: \$15n
b) $C = 15n + 825$ **c)** \$3075 **d)** 175
9. a)



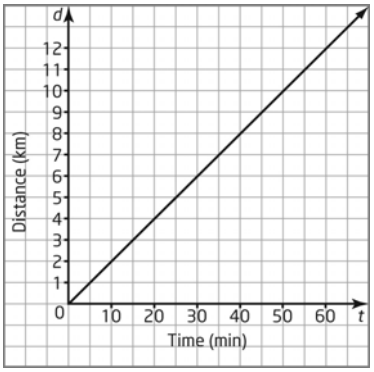
b) A: direct variation; B: partial variation
c) In both cases, C represents the cost of a membership and n represents the number of visits.
A: $C = 3n$; B: $C = 2n + 8$
d) Membership A is cheaper when fewer than eight visits are made. Membership B is cheaper when more than eight visits are made.

5.3 Slope, pages 85–86
1. 1.25
2. 0.73
3. a) $\frac{2}{3}$ **b)** $-\frac{3}{4}$ **c)** 0 **d)** not possible
4. Answers will vary. Examples:
a) B(5, 7) **b)** B(2, −1) **c)** B(3, −1) **d)** B(−5, −4)
5. Yes it does; otherwise the slopes would be different.
6. 0.2
7. 0.143
8. 1.3
9. a) 8 **b)** Yes.
10. a) steep **b)** medium **c)** shallow

5.4 Slope as a Rate of Change, pages 87–89
1. 40 km/h
2. 4 flaps/s
3. 72 beats/min
4. a) −5 **b)** The height decreases by 5 m/min.
5. a) −0.083
b) The atmospheric pressure decreases by 0.083 mbar/m.
6. 5¢/year
7. 2 m/year
8. a) Cyclist B, by 10 km/h
b) It is the time at which they have travelled the same distance. If they are travelling in the same direction, it is the time at which cyclist A passes cyclist B.
9. No.
10. a) The graph is a line starting at (0, 0) and passing through (20, 200).
b) 30 s



11. a) 0.2 km/min
b)



c) The rate of change is Selam's average running speed. It is also the slope of the graph.
12. a)

Time (h)	Price of Piano (\$)
0	1350.00
4	1215.00
8	1093.50
12	984.15

b) Graphs may vary depending on scales chosen.
c) The graph is decreasing and it is curved because the rate of change changes at each interval.
13. a)

Time (h)	Cost of Membership (\$)
0	570
2	540
4	510
6	480
8	450

b) Graphs may vary depending on scales chosen.
c) The graph is decreasing and it is linear because the rate of change is constant.
14. a) 40π cm **b)** $C = 2\pi r$ **c)** 2π cm/cm

5.5 First Differences, pages 90–92
1. a) linear **b)** linear **c)** non-linear **d)** non-linear

e) linear **f)** non-linear

2. a) linear

x	y	First Differences
0	2	
1	6	4
2	10	4
3	14	4

b) non-linear

x	y	First Differences
–3	–4	
–1	–1	3
1	1	2
3	4	3

3. a) linear **b)** non-linear

4. a)

Height (cm)	Painted Area (cm^2)
0	0.00
1	0.25
2	1.00
3	2.25
4	4.00

b) non-linear

5. a) linear; $S = 4n + 1$; 29 segments

b) non-linear: 49 tiles

6. a)

Base Side Length	Number of Triangles
1	1
2	4
3	9
4	16

non-linear; 49

b)

Base Side Length	Number of Segments
1	3
2	9
3	18
4	30

non-linear; 84

c)

Base Side Length	Number of Horizontal Lines in Shape
1	1
2	2
3	3
4	4

linear; 7; $y = x$

7. a)

Height (cm)	Wet Area (cm^2)
0	0
1	19
2	36
3	51
4	64
5	75

b) non-linear

c) 96 cm^2

8. a)

Figure Number	Number of Hexagons in Pattern
1	1
2	7
3	19
4	37

b) non-linear

5.6 Connecting Variation, Slope, and First Differences, pages 93–94

1. a) 2 **b)** 2 **c)** $y = 2x + 2$

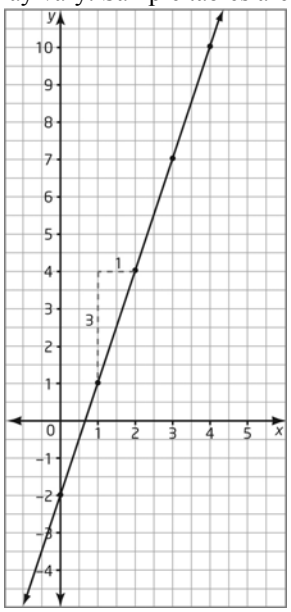
2. a) $-\frac{1}{2}$ **b)** -1 **c)** $y = -\frac{1}{2}x - 1$

3. Tables and graphs may vary. Sample tables are shown.

a)

x	y
0	–2
1	1
2	4
3	7
4	10

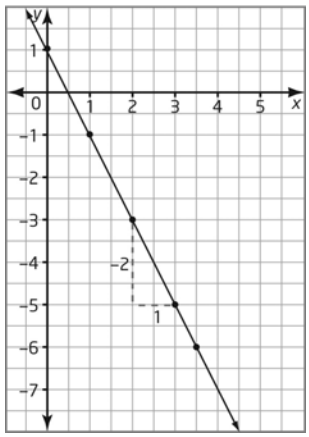
slope = 3



b)

x	y
0	1
1	–1
2	–3
3	–5
4	–7

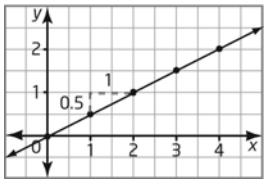
slope = −2



c)

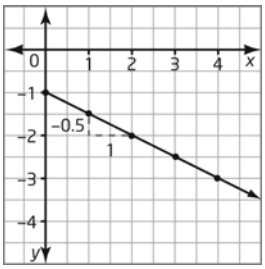
x	y
0	0
1	0.5
2	1
3	1.5
4	2

slope = $\frac{1}{2}$



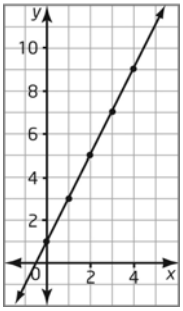
d)

x	y
0	–1
1	–1.5
2	–2
3	–2.5
4	–3



slope = −0.5

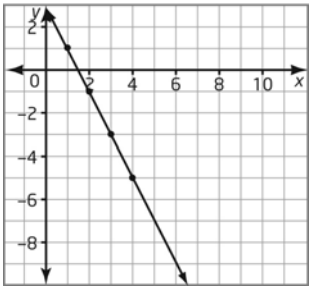
4. a)



b) Each time the value of x increases by 1, the value of y increases by 2. The graph is a straight line that does not pass through (0, 0). This is a partial variation.

c) $y = 2x + 1$

5. a)

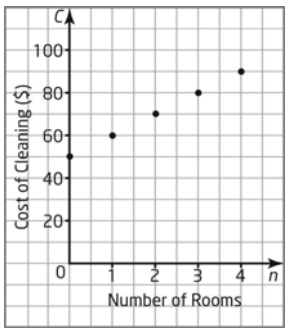


b) Each time the value of x increases by 1, the value of y decreases by 2. The graph is a straight line that does not pass through (0, 0). This is a partial variation.

c) $y = -2x + 3$

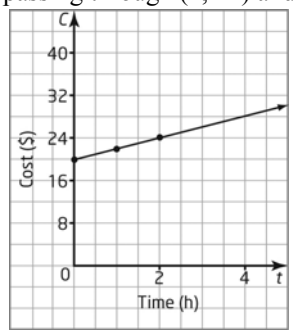
6.

Number of Rooms, n	Cost of Cleaning, C ($)
0	50
1	60
2	70
3	80
4	90



$C = 10n + 50$

7. a) The graph is a line starting at (0, 20) and passing through (1, 22) and (2, 24).



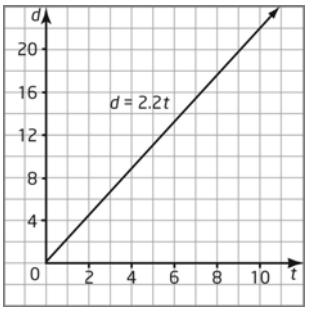
b) slope 2, cost of renting the bicycle for 1 h; vertical intercept 20, cost of renting the bicycle at the start of the rental

c) partial variation; graph is a straight line that does not pass through (0, 0)

d) $C = 2t + 20$

8. a) 2.2, 0 **b)** $d = 2.2t$

c)



9.

x	y
–2	–3
–1	–1
0	1
1	3

y varies partially with x. As the value of x increases by 1, the value of y increases by 2.

$y = 2x + 1$

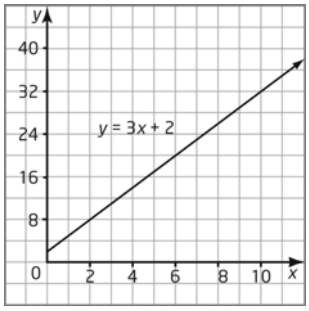
10.

x	y
–1	5
0	2
1	–1
2	–4

y varies partially with x. As the value of x increases by 1, the value of y decreases by 3. $y = -3x + 2$

11. Tables and graphs may vary. A sample table is shown.

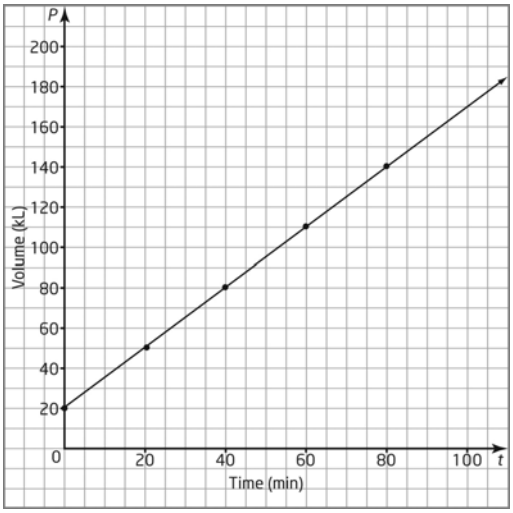
x	*y*
0	2
1	5
2	8
3	11
4	14



y varies partially with *x*. As the value of *x* increases by 1, the value of *y* increases by 3.

12. a) The relation is linear. As the value of *t* increases by 20 min, the volume of water increases by 30 kL.

b)



c) $\frac{3}{2}$, 1.5; constant; it represents that 1.5 kL of water fills the water tank every minute.

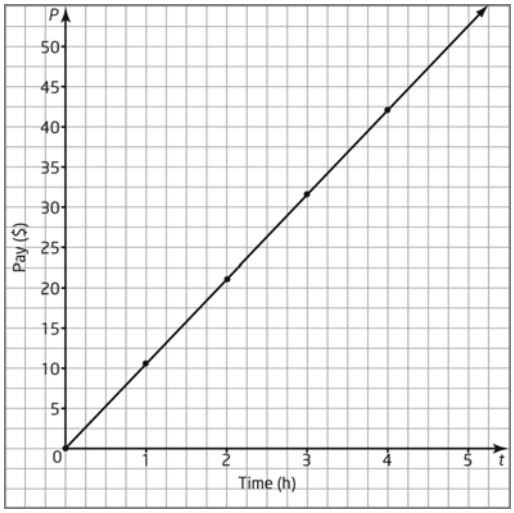
d) $V = 1.5t + 20$ **e)** 65 kL

Chapter 5 Review, pages 95–96

1. a)

Time Worked, *t* (h)	Pay, *P* ($)
0	0.00
1	10.50
2	21.00
3	31.50
4	42.00

b)

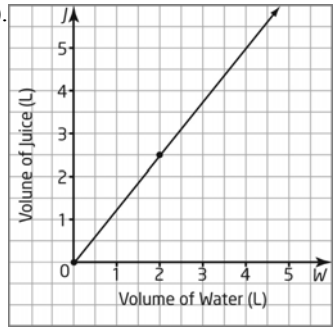


c) $P = 10.5t$

2. a) $d = 16t$; speed of 16 km/h **b)** 3.125 h

3. a) The volume of juice varies directly with the volume of water used to prepare it.

b) The graph is a line starting at (0, 0) and passing through (2, 2.5).



4. a) Partial variation: it is a straight line that does not pass through (0, 0).

b) Direct variation: it is a straight line that passes through (0, 0).

c) Neither: it is not a straight line.

5. a) Partial variation: it is a straight line that does not pass through (0, 0).

b) Direct variation: it is a straight line that passes through (0, 0).

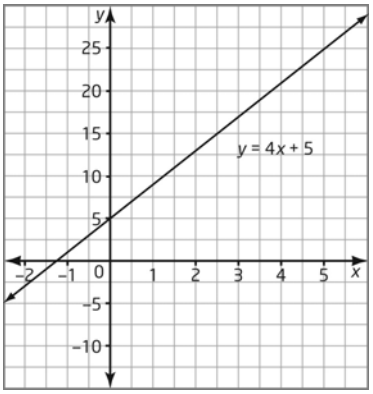
c) Neither: it is not a straight line.

6. a)

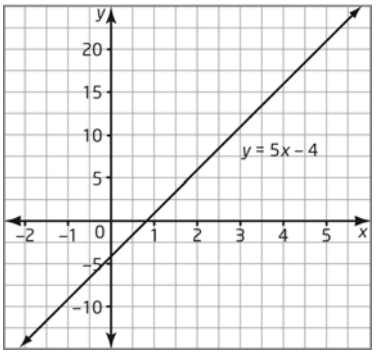
x	*y*
0	5
1	9
2	13
3	17
4	21
8	37

b) 5, 4 **c)** $y = 4x + 5$

d) The graph is a straight line that starts at (0, 5) and rises upward to the right with a slope of 4.



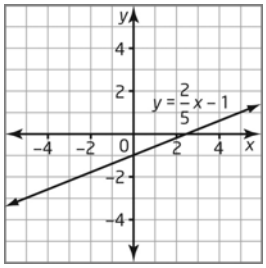
7. a) \$25; 0.02*b*, where *b* is the number of business cards.
b) $C = 0.02b + 25$ **c)** \$35
8. a) 0.375 **b)** 0.2
9. a) $\frac{4}{3}$ **b)** $-\frac{2}{7}$ **c)** 0 **d)** not possible
10. 3.5; the plant grows at a rate of 3.5 cm/month
11. a) yes **b)** no
12. a) linear **b)** non-linear
13. a) linear **b)** 5 **c)** $y = 5x - 4$
d)

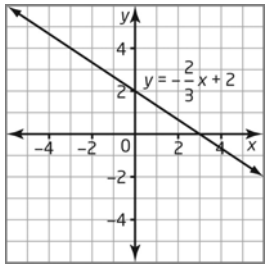


Chapter 6

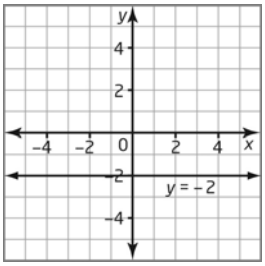
6.1 The Equation of a Line in Slope *y*-Intercept Form: $y = mx + b$, pages 97–99

1. a) slope = 3, *y*-intercept = −2
b) slope = −2, *y*-intercept = 4
c) slope = $\frac{3}{4}$, *y*-intercept = −5
d) slope = $-\frac{2}{5}$, *y*-intercept = 0
e) slope = 2, *y*-intercept = $-\frac{1}{3}$
f) slope = 0, *y*-intercept = 5
2. a) slope = 2, *y*-intercept = 1
b) slope = −3, *y*-intercept = −2
3. a) $y = 2x + 1$ **b)** $y = -3x - 2$
4. a) slope = $\frac{2}{3}$, *y*-intercept = −2
b) slope = $-\frac{3}{4}$, *y*-intercept = 3
5. a) $y = \frac{2}{3}x - 2$ **b)** $y = -\frac{3}{4}x + 3$
6. a) slope = 0, *y*-intercept = 2
b) slope = undefined, *y*-intercept = none, *x*-intercept = 3
c) slope = 0, *y*-intercept = −4
d) slope = undefined *y*-intercept = none, *x*-intercept −1
7. a) slope = 0, *y*-intercept = 1
b) slope = undefined, *y*-intercept = none, *x*-intercept = −2
c) slope = 0, *y*-intercept = 0, *x*-intercept = all real numbers
d) slope = undefined, *y*-intercept = all real numbers, *x*-intercept = 0
8. a) $y = 1$ **b)** $x = -2$ **c)** $y = 0$ **d)** $x = 0$
9. a) *x*-axis **b)** *y*-axis
10. a) $y = \frac{2}{5}x - 1$ **b)** $y = -\frac{2}{3}x + 2$

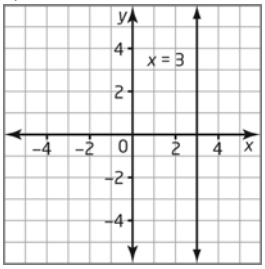




c) $y = -2$

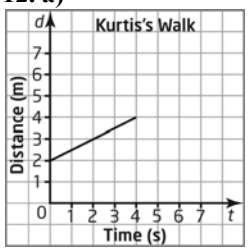


d) $x = 3$

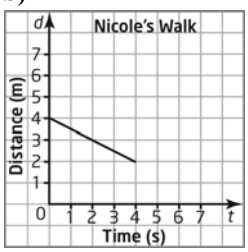


11. a) The person was an initial distance of 2 m from the sensor.
b) The person was walking at a speed of 0.4 m/s.
c) The person was walking away from the sensor. This is because on the graph, the person's distance from the sensor increases as time goes by.
d) 4 m

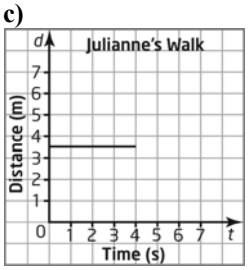
12. a)



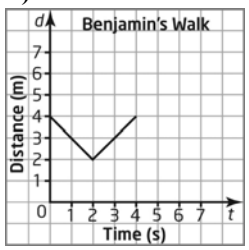
b)



c)



d)



13. a) slope 0.5, *d*-intercept 2; The slope represents Christine's walking speed of 0.5 m/s away from the sensor. The *d*-intercept represents Christine's initial distance of 2 m away from the sensor; $d = \frac{1}{2}t + 2$.

b) slope = 100, *d*-intercept 0; The slope shows that the speed is 100 km/h. The *d*-intercept shows that when the trip began, the distance was 0 km; $d = 100t$.

14. a) *x*-intercept = 3; *y*-intercept = −6

b) *x*-intercept = −10; *y*-intercept = 4

6.2 The Equation of a Line in Standard Form: *Ax* + *By* + *C* = 0, pages 100–101

1. a) $y = -x + 4$ **b)** $y = x + 2$ **c)** $y = -\frac{1}{4}x - \frac{3}{4}$

d) $y = \frac{1}{3}x - \frac{8}{3}$ **e)** $y = -\frac{2}{5}x - 2$ **f)** $y = \frac{3}{2}x + 3$

2. a) slope −1; *y*-intercept 4; the graph is a line crossing the *y*-axis at 4 and the *x*-axis at 4.

b) slope 1; *y*-intercept 2; the graph is a line crossing the *y*-axis at 2 and the *x*-axis at −2.

c) slope $-\frac{1}{4}$; *y*-intercept $-\frac{3}{4}$; the graph is a line crossing the *y*-axis at $-\frac{3}{4}$ and the *x*-axis at −3.

d) slope $\frac{1}{3}$; *y*-intercept $-\frac{8}{3}$; the graph is a line crossing the *y*-axis at $-\frac{8}{3}$ and the *x*-axis at 8.

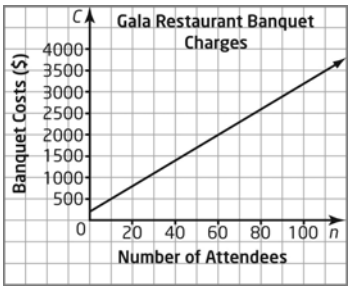
e) slope $-\frac{2}{5}$; *y*-intercept −2; the graph is a line crossing the *y*-axis at −2 and the *x*-axis at −5.

f) slope $\frac{3}{2}$; *y*-intercept 3; the graph is a line crossing the *y*-axis at 3 and the *x*-axis at −2.

3. a) $C = 30n + 200$

b) fixed cost \$200; variable cost \$30 per person

c)

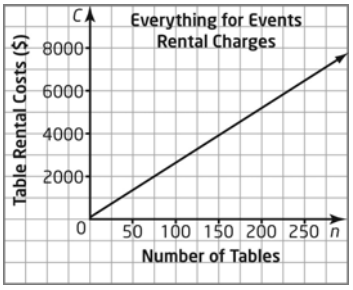


d) \$3200

4. a) $C = 25n + 100$

b) fixed cost \$100; variable cost \$25 per table

c)

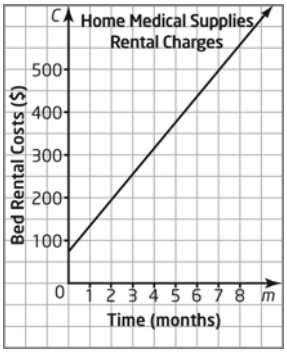


d) \$5100

5. a) $C = 60m + 75$

b) fixed cost \$75; variable cost \$60 per bed

c)

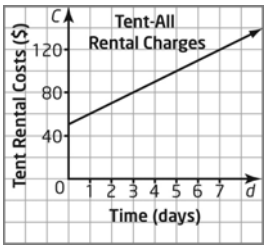


d) \$375

6. a) $C = 10d + 50$

b) fixed cost \$50; variable cost \$10 per day

c)



d) \$120

7.

Step	*Explanation*
$2x + 3y - 6 = 0$	Start with the equation in standard form.
$3y = -2x + 6$	Subtract $2x$ from both sides and add 6 to both sides.
$\frac{3y}{3} = \frac{-2x+6}{3}$	Divide both sides by 3.
$y = -\frac{2}{3}x + 2$	Divide each term on the right by 3.

8.

Step	*Explanation*
$3x + 2y + 5 = 0$	Start with the equation in standard form.
$2y = -3x - 5$	Subtract $3x$ from both sides and subtract 5 from both sides.
$\frac{2y}{2} = \frac{-3x-5}{2}$	Divide both sides by 2.
$y = -\frac{3}{2}x - \frac{5}{2}$	Divide each term on the right by 2.

9.

Step	*Explanation*
$y = -\frac{3}{4}x + 2$	Start with the equation in slope y-intercept form.
$4 \times y = 4 \times \left(-\frac{3}{4}x + 2\right)$	Multiply both sides by 4.
$4y = -3x + 8$	Simplify.
$3x + 4y - 8 = 0$	Add $3x$ to both sides and subtract 8 from both sides.

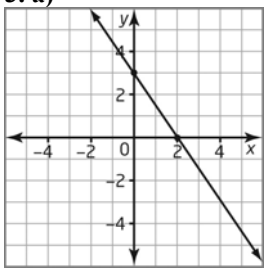
10. a) $x - y - 5 = 0$ **b)** $x + y - 3 = 0$
c) $2x - y + 5 = 0$ **d)** $3x + y - 4 = 0$
e) $2x - 5y + 20 = 0$ **f)** $8x + 12y + 9 = 0$

6.3 Graph a Line Using Intercepts, pages 102–104

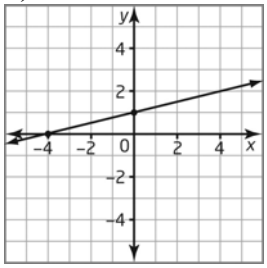
1. a) x-intercept 3; y-intercept 1
b) x-intercept -2; y-intercept -4
c) x-intercept -2.5; y-intercept 2.5

2. a) no x-intercept; y-intercept -3
b) x-intercept 2; no y-intercept
c) x-intercept 3; y-intercept -1.5

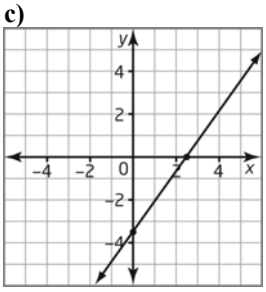
3. a)



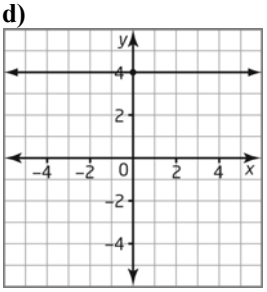
b)



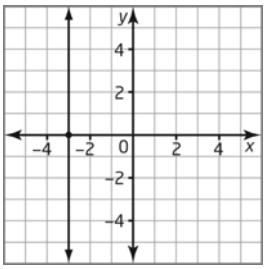
c)



d)

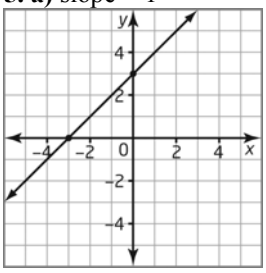


e)

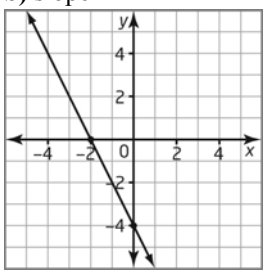


4. a) x-intercept 4; y-intercept 3
b) x-intercept 4; y-intercept 8
c) x-intercept 6; y-intercept -2
d) x-intercept -3; y-intercept 2
e) x-intercept 3; no y-intercept
f) no x-intercept; y-intercept 2

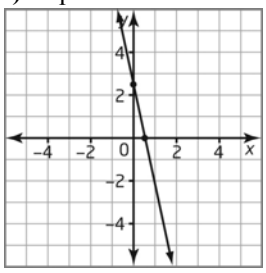
5. a) slope = 1



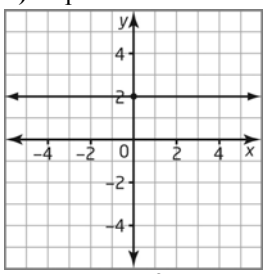
b) slope = -2



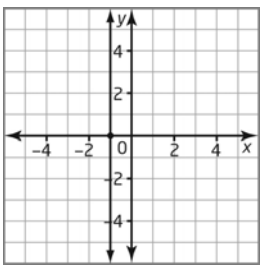
c) slope = -5



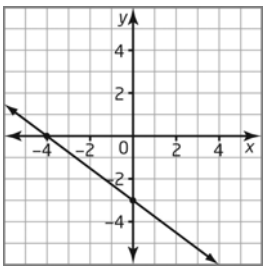
d) slope = 0



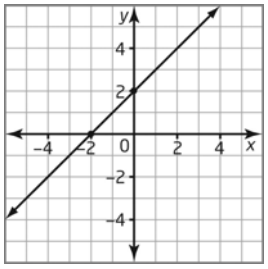
e) slope = undefined



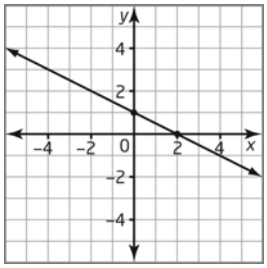
f) slope = $-\frac{3}{4}$



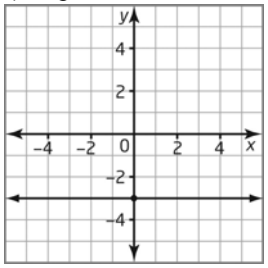
g) slope = 1



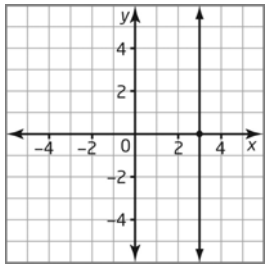
h) slope = $-\frac{1}{2}$



i) slope = 0

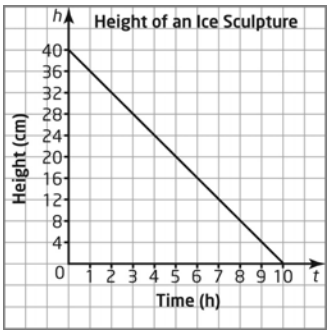


j) slope = undefined



6. a) $-\frac{4}{5}$ **b)** $\frac{5}{2}$ **c)** 2 **e)** 0 **f)** undefined

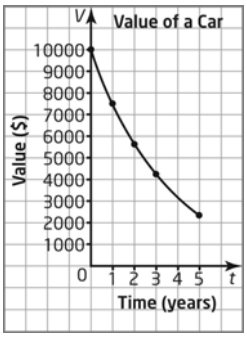
7. a) c)



b) The slope should be negative because the ice sculpture's height decreases with time.
d) 24 cm; 18 cm
e) The *t*-intercept, 10, represents the time that it takes for the ice sculpture to melt completely.
f) The graph has no meaning below the *t*-axis because a melted ice sculpture cannot have negative length.
8. a) $10 000 **b)** 20 years
c) The slope −500, shows that the value of the car decreases by $500 each year.
9. a)

Time (years)	Car's Value
0	$10000.00
1	$7500.00
2	$5625.00
3	$4218.75
4	$3164.06
5	$2373.05

b) The relation is non-linear, because the points form a curve.



c) Answers will vary. Example: The car will be worth less than 30% of its value sometime after 4 years. It will never be worth $0 because 75% of a positive number is always another positive number.
d) No. Answers will vary. Example: It does not exist because the car's value will never reach 0.
e) Answers will vary. Example: The car's value depreciates faster in the system where its value each year is 75% of its value the preceding year. This is because 75% of $10000 is more than $500, which is the amount subtracted each year in the other model.
10. a) The relation is non-linear, because the points follow a curve.
b) one *x*-intercept; 3 **c)** one *y*-intercept; −3
d)-e) Answers will vary.

6.4 Parallel and Perpendicular Lines, pages 105–106

1. a) 2, 2, parallel **b)** 4, $-\frac{1}{4}$, perpendicular

c) 3, $\frac{1}{3}$, neither **d)** $\frac{1}{2}$, $\frac{1}{2}$, parallel

e) 1, −1, perpendicular **f)** 3, 2, neither
2. a) 0, 0, parallel **b)** 0, undefined, perpendicular
c) 0, 1, neither **d)** undefined, undefined, parallel
e) 1, −1, perpendicular **f)** undefined, −1, neither
3. a) −1, −1, parallel **b)** $-\frac{3}{2}$, $\frac{2}{3}$, perpendicular

c) −2, $-\frac{1}{2}$, neither **d)** −1, 1, perpendicular

4. a) parallel; $\frac{3}{4}$ and $\frac{6}{8}$ are equivalent

b) perpendicular; 3 and $-\frac{1}{3}$ are negative reciprocals

c) neither; 5 and −5 are unequal and are not negative reciprocals

d) parallel; 0.4 and $\frac{2}{5}$ are equivalent

e) perpendicular; $2\frac{1}{2}$ and $-\frac{2}{5}$ are negative reciprocals

f) neither; $-\frac{1}{2}$ and $\frac{1}{2}$ are unequal and are not negative reciprocals
g) perpendicular; since one line is vertical and the other line is horizontal, the lines must be perpendicular.

5. a) 3 **b)** –2 **c)** $\frac{2}{3}$ **d)** $-\frac{2}{5}$ **e)** $-\frac{2}{3}$ **f)** $\frac{5}{3}$
g) undefined **h)** 0

6. a) $-\frac{1}{3}$ **b)** $\frac{1}{2}$ **c)** $-\frac{3}{2}$ **d)** $\frac{5}{2}$ **e)** $\frac{3}{2}$ **f)** $-\frac{3}{5}$
g) 0 **h)** undefined

7.

Slope of a Line	Slope of a Parallel Line	Slope of a Perpendicular Line
4	4	$-\frac{1}{4}$
−3	−3	$\frac{1}{3}$
$\frac{2}{3}$	$\frac{2}{3}$	$-\frac{3}{2}$
0	0	undefined
undefined	undefined	0

8. a) $y = -\frac{3}{2}x + \frac{7}{2}$ **b)** $-\frac{3}{2}$ **c)** $-\frac{3}{2}$
d) Answers will vary. Example: Any two lines with slope $-\frac{3}{2}$.

9. a) $y = \frac{5}{2}x + 2$ **b)** $\frac{5}{2}$ **c)** $-\frac{2}{5}$
d) Answers will vary. Example: Any two lines with slope $-\frac{2}{5}$.

10. a) x-intercept: 9; y-intercept: 6
b)

Line Equation	x-intercept	y-intercept
$2x + 3y = 12$	6	4
$2x + 3y = 6$	3	2
$2x + 3y = –6$	–3	–2
$2x + 3y = –12$	–6	–4
$2x + 3y = –18$	–9	–6

c) Answers will vary.

11. a) The slope of AB is $-\frac{1}{2}$. The slope of AC is 0. The slope of BC is 2. The slopes of lines AB and BC are negative reciprocals so ABC is a right triangle.
b) The slope of DE is $-\frac{1}{2}$. The slope of DF is $-\frac{7}{5}$. The slope of EF is –5. No two pairs of slopes are negative reciprocals so no two of lines DE, DF, and EF are perpendicular. ΔDEF is not a right triangle.
c) The slope of MN is $\frac{2}{3}$. The slope of MO is $-\frac{1}{5}$. The slope of NO is $-\frac{3}{2}$. The slopes of lines MN and NO are negative reciprocals so MNO is a right triangle.

12. a) Possible answers: (–4, 2); (–1, –1); (2, –1); (–1, –4); (–4, 5); (–7, 2)
b) There are many solutions. A few are listed in part a).

6.5 Find an Equation for a Line Given the Slope and a Point, pages 107–108

1. a) $y = 2x - 3$ **b)** $y = -4x - 14$ **c)** $y = \frac{3}{5}x - 4$
d) $y = -\frac{1}{4}x + \frac{13}{2}$

2. a) $y = -4$ **b)** $y = 3x - \frac{7}{4}$ **c)** $y = \frac{2}{3}x$
d) $y = \frac{1}{2}x - \frac{5}{2}$

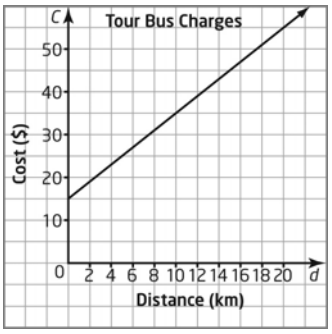
3. a) $y = 5x - 7$ **b)** $y = -4x - 7$ **c)** $y = 2x - 4$
d) $y = -\frac{1}{3}x - \frac{4}{3}$ **e)** $y = 3$ **f)** $x = -3$

4. a) $y = \frac{1}{2}x$ **b)** $y = \frac{2}{5}x - \frac{11}{5}$ **c)** $y = -2x$
d) $y = -\frac{1}{3}x$

5. $y = -\frac{3}{5}x + \frac{9}{5}$

6. $y = \frac{5}{2}x - 2$

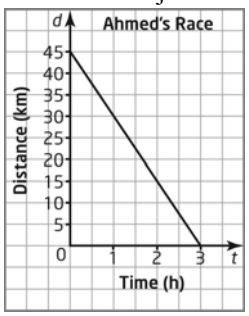
7. a) $C = 2d + 15$ **b)** \$45
c)



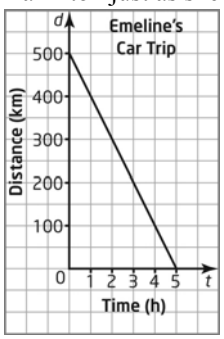
d) \$45
8. a)

Distance (km)	Cost ($)	First Differences
2	19	
3	21	2
4	23	2
5	25	2
6	27	2

b) 45 km **c)** $36 **d)** Answers will vary.
9. a) 6 **b)** $C = 3d + 6$ **c)** Answers will vary.
10. a) Answers will vary. Example: It means that after 2 h of running towards the finish line, Ahmed has 15 km left to run.
b) This value shows that for each hour that Ahmed runs, his distance from the finish line decreases by 15 km. It is negative because it represents a decreasing distance per hour.
c) 45 **d)** $d = -15t + 45$
e) The d-intercept represents Ahmed's distance from the finish line just as he started his race.



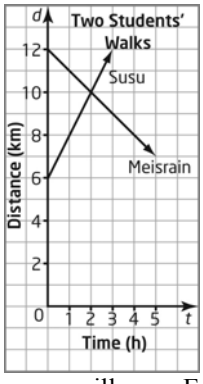
f) 3 h
g) Yes. Ahmed has run for 2 h at 15 km/h. So he has run 30 km. He still has 15 km to run. At 15 km/h this will take him another hour.
11. a) Answers will vary. Example: It means that after 2 h of driving towards Hamilton, Emeline has 300 km left to drive.
b) This value shows that for each hour that Emeline drives, her distance from the Hamilton decreases by 100 km. It is negative because it represents a decreasing distance per hour.
c) 500 **d)** $d = -100t + 500$
e) The d-intercept represents Emeline's distance from Hamilton just as she started her drive.



f) 5 h
g) No. Emeline has driven for 2 h at 100 km/h. So she has travelled 200 km. She still has 300 km to drive. At 100 km/h this will take her another 3 h.

6.6 Find an Equation for a Line Given Two Points, pages 109–111

1. a) $y = x + 1$ **b)** $y = -\frac{1}{2}x + 1$ **c)** $y = 3$ **d)** $x = 1$
2. a) $y = 2x - 2$ **b)** $y = -4x + 9$
c) $y = -\frac{5}{2}x - \frac{3}{2}$ **d)** $y = -\frac{5}{3}x + \frac{1}{3}$
3. a) $y = \frac{5}{3}x + 5$ **b)** $y = \frac{1}{2}x - 2$
4. a) $y = -2x + 4$ **b)** $y = -x - 2$
5. a) Dajanth is moving away from the sensor because he is farther away from it after 2 s than he was at the start.
b) 2.5 m/s **c)** $d = 2.5t + 2.5$
d) The d-intercept, 2.5, means that Dajanth's initial position was 2.5 m away from the motion sensor.
6. a) Helen is moving towards the sensor because she is closer to it after 8 s than she was at the start.
b) 1 m/s **c)** $d = -t + 8$
d) The d-intercept, 8, means that Helen's initial position was 8 m away from the motion sensor.
7. a) The point (2, 16.75) represents Patti's wage of $16.75/h with 2 years of experience, and the point (5, 22.75) represents Susan's wage of $22.75/h with 5 years experience.
b) slope 2; x-intercept 12.75; The slope represents the yearly wage increase, and the s-intercept represents the starting wage.
c) $s = 2n + 12.75$ **d)** $32.75
e) $52.75. Answers will vary.
8. a) Susu: $d = 2t + 6$; Meisrain: $d = -t + 12$
b) 2 s **c)** 10 m
d) Answers will vary. Example: Susu's distance has to equal Meisrain's distance, so set the right sides of the equations equal. Then, solve for t.
9. a)



b) (2, 10)
c) Answers will vary. Example: The point of intersection shows that Susu and Meisrain were both 10 m away from the sensor after 2 s. This means that they must have crossed paths at this time and distance from the sensor.
10. a) $y = -\frac{33}{28}x + \frac{106}{28}$ **b)** $y = -\frac{25}{66}x - \frac{37}{66}$

6.7 Linear Systems, pages 112–114

1. a) (−2, −3) **b)** (3, −1) **c)** (−2, 0) **d)** (0, −2)

2. a) (2, 4) **b)** (1, 1) **c)** (−2, 1) **d)** (−3, −7)

3. a) (−2, −1) **b)** (1, 2) **c)** (−2, −2)
d) (1, −2) **e)** (1, −1) **f)** (0, 4)
g) $\left(\frac{32}{31}, \frac{7}{31}\right)$ **h)** $\left(-\frac{16}{13}, \frac{15}{13}\right)$

4. a) C represents the cost of operating each car, in dollars, and d represents the distance travelled, in kilometres.
b) $d = 4000$, $C = 3600$
c) The point of intersection represents the distance travelled when the cost of operating each car is the same.
d) gas-powered car

5. a) Printer A: $C = 225 + 6p$;
Printer B: $C = 375 + 5.5p$
b) (300, 2025) **c)** 300
d) Printer A is more economical for less than 300 pages. Printer B is more economical for more than 300 pages.

6. a) First Choice: $C = 2.50 + 0.40d$
G.T.A. Taxi: $C = 3.25 + 0.25d$
b) (5, 4.50)
c) First Choice is more economical for less than 5 km. G.T.A. is more economical for more than 5 km.

7. The two equations represent the same line and are coincidental. The lines have the same slopes and the same y-intercepts.

8. $y = -\frac{5}{3}x - \frac{25}{3}$

9. a) (5, 2) **b)** (−1, 3) **c)** (2, −3)

10. (1, 4, −2)

11. The two lines never cross so no point of intersection exists. The lines have the same slopes, but different y-intercepts.

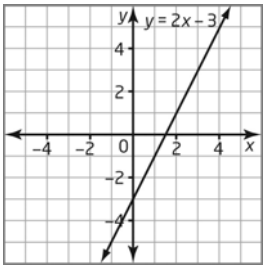
12. The two equations represent the same line and are coincidental. They have the same slopes and the same y-intercepts.

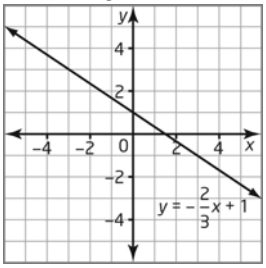
Chapter 6 Review, pages 115–116

1. a) slope 3; y-intercept −2
b) slope −2, y-intercept −2
c) slope 0; y-intercept 2
d) slope undefined; y-intercept none; x-intercept −3

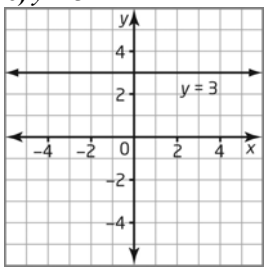
2. a) slope 4; y-intercept 2
b) slope $-\frac{5}{6}$; y-intercept 4
c) slope 0; y-intercept 5
d) slope undefined; y-intercept none; x-intercept −2

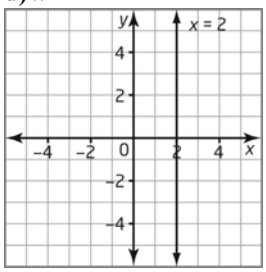
3. a) $y = 2x - 3$ **b)** $y = -\frac{2}{3}x + 1$





c) $y = 3$ **d)** $x = 2$





4. a) The slope is $\frac{1}{3}$ and the d-intercept is 2. The slope shows that the person is moving away from the motion sensor at a speed of $\frac{1}{3}$ m/s. The d-intercept shows that the person started 2 m away from the sensor.
b) $y = \frac{1}{3}x + 2$

5. a) $y = -3x + 4$ **b)** $y = \frac{2}{3}x + \frac{4}{3}$

6. a) $C = 35n + 50$
b) The slope is 35 and the C-intercept is 50. The slope shows that the electrician charges a variable cost of \$35/h and the C-intercept shows that the electrician also charges a base cost of \$50.
c) Graphs will vary depending on the scale chosen.
d) \$190

7. a) x-intercept 5; y-intercept 4
b) x-intercept 3; y-intercept −2

8. a) 6 **b)** 12
c) 1 bag of popcorn and 10 pops; 2 bags of popcorn and 8 pops; 3 bags of popcorn and 6 pops; 4 bags of popcorn and 4 pops; 5 bags of popcorn and 2 pops; also, any combination of bags of popcorn and pops that totals less than \$24.

9. a) x-intercept: 2; y-intercept: 5
b)

Line Equation	x-intercept	y-intercept
$2x - 5y = 20$	10	−4
$2x - 5y = 10$	5	−2
$2x - 5y = -10$	−5	2
$2x - 5y = -20$	−10	4
$2x - 5y = -30$	−15	6

c) Answers will vary. Example: To find the intercepts of a line perpendicular to a given line, interchange the values of x- and y-intercepts for the given line and multiply one of the intercepts by –1.

10. $y = \frac{3}{5}x - \frac{26}{5}$

11. $y = -\frac{4}{5}x + \frac{12}{5}$

12. $y = -\frac{1}{3}x - 2$

13. $y = -2x - 2$

14. $y = -6x + 10$

15. (2, 1)

16. (1, 30). This means that both piano teachers charge $30 for one hour of piano lessons.

Chapter 7

7.1 Angle Relationships in Triangles, pages 117–118

1. a) 111° **b)** 149° **c)** 127° **d)** 134°

2. a) 65° **b)** 143° **c)** 152° **d)** 115°

3. a) 170° **b)** 195° **c)** 155° **d)** 150°

4. a) 110° **b)** 149° **c)** 120° **d)** 117°

5. a) $x = 85°$

b) $x = 136°$, $y = 102°$, $z = 58°$

c) $w = 55°$, $x = 125°$, $y = 125°$, $z = 55°$

d) $w = 64°$, $x = 122°$, $y = 58°$, $z = 122°$

e) $a = 80°$, $b = 50°$, $c = 25°$, $d = 130°$, $e = 25°$

6. a) equilateral **b)** isosceles **c)** scalene

7. a) 157°

b) interior angle, 67°; exterior angle, 113°

8. $w = 47°$, $x = 90°$, $y = 42°$, $z = 43°$

9. a) 30°, 60°, and 90° **b)** 60°, 60°, and 60°

10. Answers will vary.

7.2 Angle Relationships in Quadrilaterals, pages 119–121

1. a) $a = 51°$ **b)** $b = 72°$ **c)** $c = 70°$ **d)** $d = 79°$

e) e = 69° **f)** $f = 54°$

2. a) 112° **b)** 115° **c)** 87° **d)** 121°

3. a) 88° **b)** 104° **c)** 76° **d)** 93°

4. a) $\angle D = 133°$ **b)** $\angle C = 131°$ **c)** $\angle B = 105°$

d) $\angle A = 81°$

5. a) $\angle D = 117°$ **b)** $\angle C = 100°$ **c)** $\angle B = 88°$

d) $\angle A = 91°$

6. a) $x = 78°$, $y = 102°$

b) $w = 60°$, $z = 120°$

c) $a = 134°$, $b = 46°$, $c = 134°$

7. a) $x = 72°$, $y = 108°$

b) $a = 68°$, $b = 67°$, $c = 113°$, $d = 95°$

8. a) fourth angle measures 78°

b) fourth angle measures 75°

c) impossible since $\angle A + \angle B + \angle C = 364°$

9. a) impossible; sum of four acute angles is less than 360°

b) Example: two 70° angles and two 110° angles

c) Example: two 100° angles, one 90° angle and one 70° angle

10. 90°

11. $x = 49.5°$, $y = 93°$, $z = 110.5°$, $u = 107°$, $w = 73°$

12. a) Yes. **b)** Yes. **c)** Yes. **d)** No. **e)** Yes. **f)** No.

13 a) 72°, 72°, 108°, 108°

b) 67.5°, 67.5°, 112.5°, 112.5°

7.3 Angle Relationships in Polygons, pages 122–124

1. a) 1800° **b)** 2700° **c)** 3600° **d)** 3960°

2. a) 135° **b)** 144° **c)** 154.3° **d)** 165°

3. a) 10 **b)** 6 **c)** 13 **d)** 15

4. a) 6 **b)** 10 **c)** 8

5. a) equilateral triangle **b)** square

6.

Polygon	Number of Sides	Number of Diagonals From One Vertex	Number of Triangles in the Polygon	Sum of Interior Angles
pentagon	5	2	3	540°
hexagon	6	3	4	720°
octagon	8	5	6	1080°
dodecagon	12	9	10	1800°

7. a) Sum of the interior angles is $180°(3 - 2) = 180°$. Since the angles are equal, each one measures $\frac{180°}{3}$ or 60°.

b) Sum of the interior angles is $180°(4 - 2) = 360°$. Since the angles are equal, each one measures $\frac{360°}{4}$ or 90°.

8. a) 135° **b)** Answers will vary.

c) The angles do not change.

9. b) 7 **c)** 1440°

10. a) 140° **b)** 156° **c)** 165° **d)** $\frac{180(n-2)}{n}$

11. a) 156° **b)** 24° **c)** Answers will vary.

d) 144° **e)** 36°

12. a) 150° **b)** Answers will vary.

c) The angles do not change.

13. 30°

7.4 Midpoints and Medians in Triangles, pages 125–126

1. a) 5 cm **b)** 8 cm **c)** 10 cm **d)** 26 cm

2. a) 10 cm^2 **b)** 10 cm^2

3. a) 13 cm^2 **b)** 13 cm^2

4. a) 7.5 cm^2 **b)** 7.5 cm^2

5. 3.5 m

6. a) Answers will vary.

b) Fold along each of the medians and see if the equal sides line up.

c) Construct an equilateral triangle and the three medians and then measure the angles on either side of each of the medians.
d) The medians bisect each of the angles.
7. $\angle AXZ$ is acute when A is close to Z.
8. a) An isosceles triangle with interior angles 80°, 50°, and 50° is a counter-example.
b) An isosceles triangle with interior angles 20°, 80°, and 80° is a counter-example.
9. Since ΔDEF is an equilateral triangle, the median AF bisects $\angle DEF$. So in ΔDAF, $\angle ADF = 60°$, $\angle AFD = 30°$, and $\angle ADF + \angle AFD + \angle DAF = 180°$. Therefore, $\angle DAF = 90°$. Similarly for ΔEAF. Therefore, the perpendicular at A must pass through F.
10. Right bisectors intersect at one point in all triangles.
11. a) Medians intersect at one point in all triangles.
b) Yes; the circle's radius is the minimum distance from the intersection of the medians to any side of the triangle. The circle is inscribed in the triangle.

7.5 Midpoints and Diagonals in Quadrilaterals, pages 127–128
1. a) XY is parallel to WZ, YZ is parallel to XW
b) UV is parallel to TW, TU is parallel to WV
2. KD = 8 cm, LD = 10 cm, KM = 16 cm, LJ = 20 cm
3. AE = 11 cm, BE = 10 cm
4. 120 cm
5. 60 cm
6. when EFGH is a rectangle
7. a) False; any trapezoid that has unequal bases is a counter-example.
b) True; a line segment joining opposite midpoints creates two rectangles with equal heights and bases.
8. a) rhombus
b) The area of WXYZ is half the area of ABCD. The diagonals of WXYZ form four triangles that are congruent to the triangles outside WXYZ.
c) square
d) No; all the triangles are still congruent.
9. b) 90°
c) rectangle
d), e) Answers will vary. Example: The area of WXYZ if half the area of STUV.
10. Answers will vary. Example:
b) By the Pythagorean theorem,
$DG^2 + DE^2 = EG^2 = FG^2 + EF^2$.
So DG = FG.
c) ΔDEF and ΔFGE are congruent right triangles (DE = FD, DG = FG, and EG = GE). Therefore, $\angle DEG = \angle FEG$.
11. Answers will vary. Examples:
a) The area of QRST is half the area of MNOP.
b) Use geometry software to compare the areas.
12. In any rhombus ABCD, ΔABC and ΔCDA are congruent (SSS), as are ΔABD and ΔCDB. Thus, $\angle CAB = \angle ACD$, $\angle CDB = \angle ABD$, $\angle ACB = \angle CAD$, and $\angle ADB = \angle CBD$. ΔABE and ΔCDE are congruent (ASA), so DE = BE and AE = CE.
13. ΔEFG and ΔGHE are congruent (SSS). So, $\angle EFG = \angle GHE$. Since $\angle FGE$, $\angle GEF$, and $\angle EFG$ sum to 180°, $\angle HEG + \angle GEF + \angle EFG = 180°$. Therefore, EH is parallel to FG. Similarly, EF is parallel to GH.
14. ΔABC and ΔAED are congruent (SAS). Therefore, AC = AD.

Chapter 7 Review, pages 129–130
1. a) $u = 113°$ **b)** $v = 138°$
c) $w = 113°$, $x = 78°$, $y = 35°$, $z = 102°$
d) $x = 29°$, $y = 84°$, $z = 67°$
2. The exterior angle would be greater than 180°.
3. a) any triangle
b) impossible; sum of exterior angles would be less than 360°
4. a) $x = 85°$
b) $a = 88°$, $b = 100°$, $c = 80°$, $d = 80°$, $e = 92°$
c) $x = 70°$, $y = 110°$, $z = 70°$
d) $a = 112°$, $b = 68°$, $c = 112°$, $d = 68°$, $e = 68°$
5. a) Example: three 85° angles
b) impossible: sum of interior angles would be less than 360°
6. a) 540° **b)** 900° **c)** 2340° **d)** 1620° **e)** 1080°
7. a) 120° **b)** 128.6° **c)** 150° **d)** 156°
8. a) 8 **b)** 9
9. Answers will vary.
10. GH connects the midpoints of DE and DF. Therefore, the base and altitude of ΔDGH are half those of ΔDEF.
11. a) The median to the vertex opposite the unequal side of an isosceles triangle is an altitude. This divides the isosceles triangle into two congruent right triangles. Therefore, the median bisects the angle at the vertex.
b) False; any isosceles triangle is a counter-example.
12. Explanations will vary.
a) True **b)** False **c)** True **d)** False
13. Answers will vary.

Chapter 8
8.1 Apply the Pythagorean Theorem, pages 131–133
1. a) 5 cm **b)** 25 m **c)** 6.4 cm **d)** 9.4 m
2. a) 8 cm **b)** 17.0 m **c)** 6.8 cm **d)** 12.6 m
3. a) 28 cm^2 **b)** 41 m^2
4. a) 4.5 **b)** 3.2 **c)** 4.2 **d)** 5.4
5. 166 cm
6. 38 m
7. a) 86 m **b)** 300 m^2

c) Step 1: Use the Pythagorean theorem to find the length of the unknown side.
Step 2: Add the dimensions of the outer boundary to determine the perimeter.
Step 3: Use the formula for the area of a triangle.
8. 81 cm
9. a) $\sqrt{8}$; $\sqrt{12}$; $\sqrt{16}$; $\sqrt{20}$
b) $\sqrt{4} + \sqrt{8} + \sqrt{12} + \sqrt{16}$
c) As you add right triangles to the spiral pattern, the area will increase by $\sqrt{4 \times \text{number of triangles}}$.
10. a)

Length Side, *a*	Length Side, *b*	Hypotenuse
3	4	5
5	12	13
7	24	25
9	40	41
11	60	61
13	84	85
15	112	113

b) Answers will vary.

8.2 Perimeter and Area of Composite Figures, pages 134–136
1. a) 48 m **b)** 39.6 m **c)** 24.8 cm
2. a) 27.2 cm **b)** 29.2 cm **c)** 24.3 cm
3. a) 54 cm^2 **b)** 660 m^2 **c)** 38 cm^2 **d)** 46 m^2
4. a) 297 cm **b)** 5664 cm^2
c) Step 1: Use the Pythagorean theorem to find the length of the unknown sides.
Step 2: Add the dimensions of the outer boundary to determine the perimeter.
Step 3: To find the area, determine the area of the rectangular area and the area of the triangular area and then add the areas together.
5. a) 20.8 m **b)** 19.5 m^2
6. 300 mm^2
7. Answers will vary.
8. a) 2.8 m **b)** 11 m
9. 3600 cm^2
10. a) 32 m^2
b) The area of the swimming pool is four times the area of one of the triangular decks.
c) Yes. Answers will vary.
11. 75 cm^2

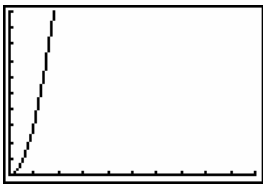
8.3 Surface Area and Volume of Prisms and Pyramids, pages 137–138
1. a) 337.6 cm^2 **b)** 85.8 cm^2
2. a) 4167 mm^3 **b)** 7 m^3
3. a) 908 mm^2 **b)** 192 cm^2
4. a) 1008 cm^3 b) 19 m^3
5. a) 94 m^2 **b)** 60 m^3
6. 25 cm
7. a) 2 552 129 m^3 **b)** 137 400 m^2
8. a) 4900 cm^3 **b)** 4.9 L
9. a) 198 m^3 **b)** 11 **c)** $250.17
10. a) 98 m^2 **b)** $693.50

8.4 Surface Area of a Cone, pages 139–140
1. a) 31 m^2 **b)** 905 cm^2 **c)** 1508 cm^2 **d)** 452 m^2
2. a) 25 m **b)** 704 m^2
3. a) 495 cm^2
b) Answers will vary. There is no aluminum being overlapped.
4. a) Yes.
b) No. The second cone. The slant height is the same for both, but in the expression πrs , the second cone has the greater radius.
c) 213.6 cm^2; 343.1 cm^2
5. a) 8 cm **b)** 6 cm
6. No. Answers will vary. Example: The formula for the surface area of a cone is $SA = \pi r^2 + \pi rs$. When the height is tripled only the term πrs is changed. The term πr^2 remains unaltered. Hence, tripling the height of a cone does not triple the surface area.
7. No. Answers will vary. Example: The formula for the surface area of a cone is $SA = \pi r^2 + \pi rs$. When the radius is tripled the term πr^2 will be 9 times the size and the term πrs will triple. Hence, the surface area of the new cone will be more than three times the original cone.
8. a) radius 8 cm, height 16 cm **b)** slant height 18 cm
c) 653 cm^2
9. a) radius 9 cm, height 22 cm **b)** slant height 24 cm
c) 933 cm^2
10. 395 m^2
11. 307 m^2
12. Answers will vary.
13. a) height = y, radius = $\frac{y}{2}$, slant height = $\sqrt{\frac{5y^2}{4}}$
b) $SA = \frac{\pi y}{2}\sqrt{\frac{5y^2}{4}} + \frac{\pi y^2}{4}$
14. a) $r = \frac{\text{Lateral Area}}{\pi s}$ **b)** 2.9 cm

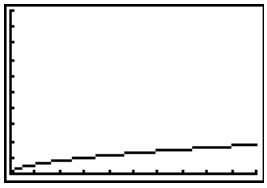
8.5 Volume of a Cone, pages 141–143
1. a) 94 cm^3 **b)** 101 cm^3 **c)** 50 m^3 **d)** 308 m^3
2. a) 19 cm^3 **b)** 49 cm^3 **c)** 1018 m^3 **d)** 6 m^3
3. 403.2 cm^3
4. 4 cm
5. 3 cm
6. 200 cm^3
7. Answers will vary.
8. 240 cm^3
9. a) Answers will vary. Example: 7 m
b) 6 m
c) Answers will vary.

10. 389.9 cm^3
11. a) Answers will vary. Example: The cone with base radius of 6 cm has the greater volume. The formula for the volume of a cone contains two factors of r and only factor of h. Hence, the volume is more dependent on r than on h.
b) Cone (height 6 cm, base radius 5 cm):
Volume = 157 cm^3
Cone (height 5 cm, base radius 6 cm):
Volume = 188 cm^3
12. a) $h = \frac{3V}{\pi r^2}$ **b)** 6.4 cm
13. a) $r = \sqrt{\frac{3V}{\pi h}}$ **b)** 10.9 cm
14. 6.9 cm
15. 8.0 m

8.6 Surface Area of a Sphere, pages 144–145
1. a) 804 cm^2 **b)** 31 794 mm^2 **c)** 314 m^2
d) 129 m^2
2. 1.9 cm
3. 4.6 cm
4. a) 2026.8 cm^2 **b)** \$5.07
5. a) 2189.6 cm^2 **b)** \$7.01
6. a) 2463 cm^2 **b)** \$0.49
7. 491 m^2
8. 3 141 593 km^2
9. 1257 cm^2
10. a) Answers will vary. Example: 900 cm^2
b) 1018 cm^2
c) Answers will vary.
11. a) $SA = \pi d^2$ **b)**



c) The diameter must be greater than 0. As the diameter increases, the surface area also increases in a non-linear pattern.
d) 227 cm^2, 4.4 cm
12. a) $d = \sqrt{\frac{SA}{\pi}}$ **b)**



c) The diameter and the surface area must be greater than 0. The trend between the two variables is non-linear with the diameter increasing as the surface area increases but at a slow rate.
d) 13.8 cm
13. The surface area has increased by a factor of sixteen.
$SA_{old} = 4\pi r^2$
$SA_{new} = 4\pi(4r)^2$
$= 4\pi(16r^2)$
$= 16(4\pi r^2)$
14. The cube with edge length 16.

8.7 Volume of a Sphere, pages 146–148
1. a) 15 002 cm^3 **b)** 91 952 mm^3 **c)** 333 m^3
d) 4849 m^3
2. 14 137 cm^3
3. 221 cm^3
4. 21 990 642 870 km^2
5. 113 cm^3
6. a) 382 cm^3 **b)** 729 cm^3 **c)** 347 cm^3
7. 65 450 mm^3
8. a) 8181.2 cm^3 **b)** 1963.5 cm^2
9. a) 1098.5 cm^3 **b)** 760.5 cm^2 **c)** 523.3 cm^3
d) Answers will vary. Example: the tennis balls are packed closely together and the sides of the ball meet the rectangular prism package at the sides and at the top of the package.
10. a) Answers will vary.
b) 1642 m^3 **c)** 1313 cm^3 **d)** 12 truckloads
11. 1.3 m^3
12. a) 1 098 066 219 000 km^3
b) 927 587 170 500 km^3
c) 170 479 048 500 km^3
d) Answers will vary. Example: The Earth and Venus are perfect spheres.
13. Estimates will vary. Actual radius is 4.92 cm.
14. 5.2
15. a) Answers will vary. Example: 1:2
b) Volume of sphere = 113 cm^3
Volume of cube = 216 cm^3
Ratio: $\pi : 6$
c) Answers will vary.

Chapter 8 Review, pages 149–150
1. a) perimeter 27.8 cm; area 29.4 cm^2
b) perimeter 17.4 cm; area 13.0 cm^2
2. 3.9 m
3.perimeter 24.2 cm; area 37.5 cm^2
4. perimeter 25.4 cm; area 36.3 cm^2
5. a) 439.9 m **b)** 502.7 m **c)** 62.8 m
6. a) 158 cm^2 **b)** 8734 mm^2
7. a) 2000 m^3 **b)** 996 m^2
c) Answers will vary. Example: The side walls of the greenhouse are made of pieces of glass that are joined very closely.

d) Answers will vary. Example: The answer is fairly reasonable as when constructing a greenhouse, you want the pieces of glass to be as close together as possible.
8. 16.8 cm
9. 530.1 cm^2
10. 2173 cm^2
11. 2.8 cm
12. 415 cm^3; $\text{Volume}_{\text{Cone}} = \frac{1}{3} \times \text{Volume}_{\text{Cylinder}}$
13. 1720.2 cm^2
14. a) 72 505 502 km^2 **b)** Mars is a sphere.
15. 268.1 cm^3
16. a) Answers will vary. Example: about 250 cm^3
b) 243.9 cm^3 **c)** Answers will vary.

Chapter 9

9.1 Investigate Measurement Concepts, pages 151–153

1. a) Investigate the dimensions of various rectangles with a perimeter of 22 units.
b) Answers will vary. Example:

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	10	22	10
2	2	9	22	18
3	3	8	22	24
4	4	7	22	28
5	5	6	22	30

2. a) Investigate the dimensions of various rectangles with an area of 18 square units using a geoboard.
b) Answers will vary. Example: Let the space between the two pins be 1 unit and use an elastic band to make different rectangles with an area of 18 square units. Start with a width of 1 unit and increase by intervals of one, and find the necessary length.

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	18	38	18
2	2	9	22	18
3	3	6	18	18

3. a)

Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	36	74	36
2	2	18	40	36
3	3	12	30	36
4	4	9	26	36
5	6	6	24	36

b) The greater the perimeter, the more expensive the garage; the smaller the perimeter, the lower the cost.
c) Rectangle 5 (a square) with dimensions 6 m by 6 m will be the most economical.
d) Answers will vary. Example: The quality of the material used to construct the garage and what will be stored in it.

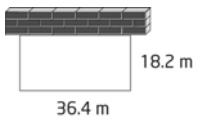
4. a)

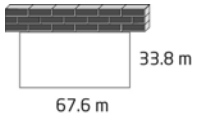
Rectangle	Width (m)	Length (m)	Perimeter (m)	Area (m^2)
1	1	64	130	64
2	2	32	68	64
3	4	16	40	64
4	8	8	32	64

b) The greater the perimeter, the more expensive the room; the smaller the perimeter, the lower the cost.
c) Rectangle 4 (a square) with dimensions 8 m by 8 m will be the most economical.
d) Answers will vary. Example: The quality of the material used to construct the room and what will be stored in it.
5. A rectangle with dimensions 5 m by 5 m encloses the greatest area for the same amount of fencing.
6. A rectangle with dimensions 7 m by 7 m encloses the greatest area for the same amount of fencing.
7. 144 m^2
8. 324 m^2
9. b) triangle: equilateral with each side 16 m, area: 110.9 m^2
rectangle: square with each side 12 m, area: 144 m^2
hexagon: regular with each side 8 m, area: 166.3 m^2
octagon: regular with each side 6 m, area: 173.8 m^2
circle: radius of 7.64 m, area: 183.4 m^2
c) Yes. Different shapes allow for different areas. The greatest area can be achieved by using a circle.

9.2 Perimeter and Area Relationships of a Rectangle, pages 154–155

1. a) 7 m by 7 m **b)** 10 m by 10 m **c)** 12 m by 12 m
d) 16.25 m by 16.25 m
2. a) Answers may vary. Example: 1 m by 4 m, 1.4 m by 3.6 m, 2.5 m by 2.5 m
b) 2.5 m by 2.5 m
3. a) 19.5 m by 19.5 m
b) No. 19.5 m cannot be created using 2-m barriers.
c) 19.25 m^2
4. a) 331.24 m^2 **b)** 1142.44 m^2
5. a) extra 331.24 m^2 **b)** extra 1142.44 m^2



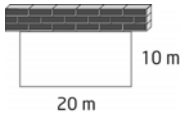


6. 10 m by 5 m
7. a)

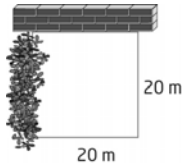
Rectangle	Width (m)	Length (m)	Area (m^2)	Length of Fence Used (m)
1	1	50	50	52
2	2	25	50	29
3	3	16.7	50	22.7
4	4	12.5	50	20.5
5	5	10	50	20

	A	B	C	D	E
1	Rec-tangle	Width (m)	Length (m)	Area (m^2)	Length of Fence Used (m)
2	1	1	=50/B2	50	=C2+2*B2
3	2	=B2+1	=50/B3	50	=C3+2*B3
4	3	=B3+1	=50/B4	50	=C4+2*B4
5	4	=B4+1	=50/B5	50	=C5+2*B5

b) 5 m by 10 m **c)** 20 m
8. 4 sides: a square with sides each 10 m; area 100 m^2
3 sides: a rectangle 20 m by 10; area 200 m^2



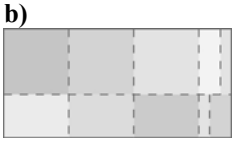
2 sides: a square with sides 20 m; area: 400 m^2



9. Answers will vary.
10. Answers will vary.
11. 6.48 m by 6.48 m
12. 4 m by 8 m
13. a) an equilateral triangle with side length 8.66 cm
b) an equilateral triangle with side length 13.86 cm
c) an equilateral triangle with side length 19.05 cm

9.3 Minimize the Surface Area of a Square-Based Prism, pages 156–158
1. a) 9 cm by 9 cm by 9 cm
b) 11 cm by 11 cm by 11 cm
c) 9.3 cm by 9.3 cm by 9.3 cm
d) 10.9 cm by 10.9 cm by 10.9 cm
e) 9.1 cm by 9.1 cm by 9.1 cm
f) 8.2 cm by 8.2 cm by 8.2 cm
2. a) 486 cm^2 **b)** 726 cm^2 **c)** 519 cm^2
d) 713 cm^2 **e)** 497 cm^2 **f)** 403 cm^2
3. C, A, B. Answers will vary.
4. a) cube with a side length of 53.1 cm
b) Answers will vary.
5. cube with a side length of 16.3 cm
6. a) 17.7 cm by 17.7 cm by 17.7 cm
b) Answers will vary.
7. a) 11.45 cm by 11.45 cm by 11.45 cm
b) 786.6 cm^2
8. Answers will vary.
9. a) 17.7 cm by 17.7 cm by 17.7 cm
b) 1880 cm^2
10. a) 21.25 cm by 21.25 cm by 21.25 cm
b) 2709.4 cm^2
11. a) 26.8 cm by 26.8 cm by 13.4 cm
b) different
c) The lidless box requires less material.
12. a) cube with a side length 5.6 cm
b) Answers will vary. Example: Cubical boxes are harder to hold.
c) Answers will vary.
13. a) 3.2 cm by 3.2 cm by 3.2 cm
b) Answers will vary. Example: The bags of microwave popcorn could not be folded to fit in the box.
c) Answers will vary.
14. Try to get the square-based prism to be as close to a cube in shape as possible. The dimensions are 4 by 4 by 3.

9.4 Maximize the Volume of A Square-Based Prism, pages 159–160
1. A, C, B
2. a) 7 cm by 7 cm by 7 cm
b) 12 m by 12 m by 12 m
c) 10 cm by 10 cm by 10 cm
d) 16 m by 16 m by 16 m
e) 15.8 cm by 15.8 cm by 15.8 cm
f) 17.3 m by 17.3 m by 17.3 m
3. a) 343 cm^3 **b)** 1728 m^3 **c)** 1000 cm^3
d) 4096 m^3 **e)** 3944 cm^3 **f)** 5178 m^3
4. 11.9 cm by 11.9 cm by 11.9 cm
5. a) 2520 cm^2; 7448 cm^3
b) 20.5 cm by 20.5 cm by 20.5 cm
c) 8615 cm^3
6. a) 28.8 m^2; 10.4 m^3 **b)** 2.2 m by 2.2 m by 2.2 m
c) 11 m^3
7. a) 109.1 m^2; 50.0 m^3 **b)** 4.3 m by 4.3 m by 4.3 m
c) 80 m^3
8. a) 1.6 m by 1.6 m by 1.6 m **b)** 4 m^3
9. a) 1.8 m by 1.8 m by 1.8 m **b)** 6 m^3
10. a) 51.6 cm by 51.6 cm by 51.6 cm
b) 137 388 cm^3 **c)** 83 488 cm^3
d) Answers will vary. Example: There is no empty space in the box. The stereo system would fit into the cube with enough room around the edges for the shredded paper. The shredded paper is tightly packed.
11. a) 86.6 cm by 86.6 cm by 86.6 cm
b)



c) Answers will vary. Example: Assume that Philip cuts the wood carefully to not waste any pieces, and glues pieces together.

9.5 Maximize the Volume of a Cylinder, pages 161–162
1. a) $h = 17.24$ cm, $r = 8.62$ cm
b) $h = 2.06$ m, $r = 1.03$ m
c) $h = 25.24$ mm, $r = 12.62$ mm
d) $h = 9.22$ cm, $r = 4.61$ cm
e) $h = 4.12$ m, $r = 2.06$ m
f) $h = 30.90$ mm, $r = 15.45$ mm
2. a) 4024 cm^3 **b)** 7 m^3 **c)** 12 629 mm^3

d) 616 cm^3 **e)** 55 m^3 **f)** 23 172 mm^3
3. a) $r = 2.1$ m, $h = 4.2$ m **b)** 58 189 L
c) Answers will vary. Example: No metal will be wasted in the building process, and no metal is being overlapped.
4. a) $r = 0.7$ m, $h = 1.4$ m **b)** 2155 L
c) Answers will vary. Example: No metal will be wasted in the building process, and no metal is being overlapped.
5. a) $r = 1.3$ m, $h = 2.6$ m **b)** 14 m^3
6. a) 12.2 cm **b)** 61 DVDs
c) Answers will vary. Example: Only the dimensions of the DVDs need to be considered; no extra space is left for the container's closing mechanism, the plastic container has no thickness.
7. a) $r = 7.35$ cm, $h = 14.70$ cm **b)** 73 CDs
8. a) Answers will vary.
b) cylinder: $r = 13.6$ cm, $h = 27.2$ cm,
volume 15 805 cm^3;
square-based prism: $s = 24.2$ cm,
volume 14 172 cm^3
9. a) Answers will vary. Example: Adjust the surface area formula for the new cylinder, isolate the height and run a few trials using a spreadsheet to find the maximum volume.
b) $h = 9.2$ cm, $r = 9.2$ cm, volume 2454 cm^3
10. a) Answers will vary.
b) square-based prism: $s = 22.36$ cm
cylinder: $r = 12.62$ cm, $h = 25.24$ cm
sphere: $r = 15.45$ cm
c) square-based prism: 11 179.3 cm^3
cylinder: 12 628.7 cm^3
sphere: 15 448.1 cm^3
d) The sphere has the greatest volume. Yes, this will always be the case.
e) For a given surface area:
volume of a sphere **>** volume of a cylinder
> volume of a square-based prism
11. a) $r = 0.564$ m, $h = 1.128$ m
b) r = 0.798 m, h = 0.798 m

9.6 Minimize the Surface Area of a Cylinder, pages 163–164

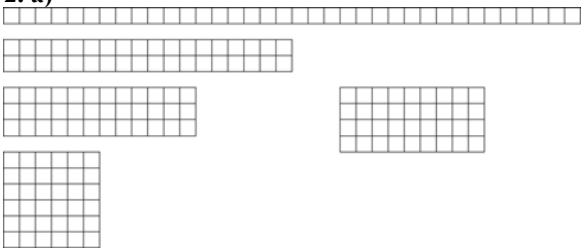
1. a) $r = 6.1$ cm, $h = 12.2$ cm **b)** $r = 0.9$ m, $h = 1.8$ m
c) $r = 3.9$ mm, $h = 7.8$ mm **d)** $r = 1.2$ cm, $h = 2.4$ cm
e) $r = 5.0$ m, $h = 10.0$ m **f)** $r = 1.6$ mm, $h = 3.2$ mm
2. a) 701 cm^3 **b)** 15 m^3 **c)** 287 mm^3
d) 27 cm^3 **e)** 471 m^3 **f)** 48 mm^3
3. $r = 5.2$ cm, $h = 10.4$ cm
4. $r = 4.2$ cm, $h = 8.4$ cm
5. a) $r = 9.8$ cm, $h = 19.6$ cm
b) Answers will vary. Example: No extra material will be needed to enclose the volume.
6. a) $r = 3.8$ cm, $h = 7.6$ cm
b) Answers will vary. Example: No extra material will be needed to enclose the volume.
7. a) $r = 4.3$ cm, $h = 8.6$ cm **b)** \$12.55
8. a) $r = 4.8$ cm, $h = 9.6$ cm **b)** \$7.82
9. a) $r = 3.8$ cm, $h = 7.6$ cm **b)** \$14.70
10. a) $r = 43.0$ cm, $h = 86.0$ cm **b)** \$348.53
11. A cube will have a surface area of 269 cm^2, and a cylinder will have a surface area of 244 cm^2. A cylinder is more cost efficient.
12. a) $r = 7.26$ cm, $h = 7.25$ cm **b)** 496 cm^2
c) Answers will vary. Example: The only cardboard needed is used to enclose the required volume so there is no wastage.
13. a) Answers will vary.
b) prism: 712.9 cm^2, cylinder: 656.2 cm^2,
sphere: 581.1 cm^2; The sphere has the least surface area.

Chapter 9 Review, pages 165–166

1. a)

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	14	30	14
2	2	13	30	26
3	3	12	30	36
4	4	11	30	44
5	5	10	30	50
6	6	9	30	54
7	7	8	30	56

b) There are seven possible rectangles when the side measurements are whole numbers.
c) I would choose the 7 m by 8 m shape, because it has the greatest area.
2. a)



b)

Rectangle	Width (units)	Length (units)	Perimeter (units)	Area (square units)
1	1	36	74	36
2	2	18	40	36
3	3	12	30	36
4	4	9	26	36
5	6	6	24	36

c) I would choose the 6 m by 6 m shape, because for the same enclosed area, it has the least perimeter. Thus, fewer edging bricks will be required.
3. 2 m by 2 m
4. a) 1600 m^2 **b)** 3200 m^2
5. a) 28.3 m by 28.3 m
b) Answers will vary. Example: A square parking lot may not be best design for convenient parking of cars.

6. 9.8 m by 9.8 m by 9.8 m
7. a) 9.3 m by 9.3 m by 9.3 m
b) Answers will vary. Example: The surface area of a cylinder that contains the same volume will be less than the surface area of the box. The manufacturer could save on packaging costs.
8. 953 cm^2
9. 0.71 m by 0.71 m by 0.71 m
10. 22.4 cm by 22.4 cm by 22.4 cm
11. It is not possible to cut six 22.4 cm by 22.4 cm pieces from a 30 cm by 100 cm piece of cardboard because only four such pieces fit.
12. r = 5.74 cm, h = 11.48 cm; volume 1188.27 cm^3
13. Answers will vary. Example A cylinder will have a greater volume using the same amount of cardboard but the square-based prism may be easier for customers to store.
14. a) 324.64 cm^2, when r = 4.15 cm, h = 8.30 cm
b) Answers will vary. Example: There is not waste while making the pop can.

Challenge Questions

Challenge Questions 1, page 167

1. The first number in each pair represents a number from the first set, the second a number from the second set. (1, 8), (2, 2), (3, 13), (4, 12), (5, 11), (6, 10), (7, 9), (8, 1), (9, 7), (10, 6), (11, 5), (12, 4), (13, 3)
2. forty
3. 5 times
4. 126 cm
5. 79, 80, 81, 82, 83
6. 0, 4, or 8
7. a) 14, 16 **b)** $2n + 6$ **c)** 58 **d)** 43rd
8. 112 cm
9. 7
10. 20, 22, or 26

Challenge Questions 2, page 168

1. 32 cm
2. 8
3. 1; 3; 5; 8; 19; 39; 199; $2n$ -1
4. 1, 5, 15, 30, 45, 51, 45, 30, 15, 5, 1;
1, 6, 21, 50, 90, 126, 141, 126, 90, 50, 21, 6, 1;
1, 7, 28, 77, 161, 266, 357, 393, 357, 266, 161, 77, 29, 7, 1
5. 84
6. 11
7. Answers will vary
8. Answers will vary

Challenge Questions 3, page 169

1. 1 unit: 17; 2 units: 6; 3 units: 3; 4 units: 1; 5 units: 1
2. A is 4, B is 2, C is 3, and D is 1
3. 15, 21, 28
4. $593.75
5. 2 cm
6. 2, 1; 3, 4, 5; 7, 6
7. 9
8. Answers will vary.

Challenge Questions 4, page 170

1. a) 14 **b)** $t = 2p + 2$
2. 542.5 km
3. $5\frac{9}{28}$
4. 4
5. a) 17, 21
b) The number of toothpicks is one more than four times the diagram number.
c) $4n + 1$ **d)** 201, 321
6. Tuesday
7. 05:55
8. 13
9. Answers will vary.

Challenge Questions 5, page 171

1. 1 cm^2
2. 1, 3, 4, 7, 8, 9
3. 17
4. Saturday
5. 4 quarters; 3 quarters, 5 nickels; 2 quarters, 10 nickels; 1 quarter, 15 nickels; 20 nickels
6. 20
7. $\frac{5}{2}+\frac{4}{3}$
8.

Spend	Change
$1.85	$8.15
$3.65	$6.35
$4.55	$5.45
$5.45	$4.55
$6.35	$3.65
$7.25	$2.75
$8.15	$1.85

9. 15:00
10. yes
11. Answers will vary.

Challenge Questions 6, page 172

1. Answers will vary. For example:
$\left(9+\frac{9}{9}\right)\times\left(9+\frac{9}{9}\right)=100$
2. 47, 48, 49
3. $277.\overline{7}$
4. a) 6 **b)** 4 **c)** 2
5. 3 nickels, 2 dimes, 5 quarters
6. 27
7. a) 180 **b)** 8 **c)** 44 **d)** 48
8. 11, 12, 13

9. 35, 12, 23
10. Answers will vary.
11. 06:35
12. Answers will vary.
13. 7 cm
14. Answers will vary.

Challenge Questions 7, page 173
1. 10 201, 40 804, 91 809, $404 \times 404 = 163\,216$, $505 \times 505 = 255\,025$
2. 6
3. a) 25 **b)** 51
4. Answers will vary.
a) yes; 20, 9, 6, 6 **b)** yes; seven 6s
c) no **d)** yes; 20, four 6s
5. $\frac{1}{24}$
6. 2 $5 bills, 1 $2 coin, 1 quarter, 1 dime, 1 nickel, and 3 pennies
7. Answers will vary.
8. Answers will vary.
9. 212, 213
10. Answers will vary. Example: 154, 42, or 126

Challenge Questions 8, page 174
1. Answers will vary. For example:
a) 6 + 7 + 8 + 9 + 10 + 11 + 12
b) 33 + 34 + 35 + 36
2. 3, 5; 7, 1, 8, 2; 4, 6
3. Wednesday
4. 1125 m
5. Answers will vary.
6. 14
7. 4624
8. Answers will vary.
9. Answers will vary.
10. a) 22, 26 **b)** $4l - 6$ **c)** 50, 154
11. 11, 12, 13, 15, 17, 19

Challenge Questions 9, page 175
1. January 1, December 31
2. 2.5 min, assuming the animals can keep up that speed for 1 km.
3. 63
4. Answers will vary.
5. February and March
6. 34
7. Answers will vary.
8. 49
9. a) Lauryn wins by 1 m.
b) Lauryn and Yolanda run at the same average speed as in the first race.
10. 16
11. thirty-one or thirty-three
12. 78
13. Answers will vary.

Challenge Questions 10, page 176
1. 19
2. 48.5 square units
3. a) $4 \times 5 - 12 = 8$ **b)** $3 + 14 - 7 = 10$
c) $6 + 7 + 8 \div 4 = 15$ **d)** $5 + 6 + 11 - 3 = 19$
4. three 15-year-olds and two 14-year olds
5. 43
6. a) 13 + 15 + 17 + 19 = 64
b) 21 + 23 + 25 + 27 + 29 = 125
c) 31 + 33 + 35 + 37 + 39 + 41 = 216
d) It is the mean of the numbers.
e) 43 + 45 + 47 + 49 + 51 + 53 + 55 = 343
7. Answers will vary.